U.S. Environmental
Protection Agency

**Atmospheric
Pollution
Prevention
Division**

A Manual For Use with the Distribution Transformer Cost Evaluation Model (DTCEM)

Version 1.5 Beta

June 1998

DTCEM User's Manual

TABLE OF CONTENTS

CHAPTER 1. INTRODUCTION 1

Installing the DTCEM Software 1
The DTCEM Package 1
Required Equipment 1
Recommended Equipment 1
Installation Instructions 1

Primer - How to Evaluate a Transformer Bid. 2

Organization of this Manual 3

CHAPTER 2. ANALYZING TRANSFORMER COSTS WITH KNOWN A AND B VALUES 5

2.1 Entering Information Into the DTCEM Interview 5
Step 1. Enter Utility Information 6
Step 2. Enter Financial Factors 7
Step 3. Select a Calculation Method 8
Step 4. Enter Transformer Type and Size 9
Step 5. Enter A and B Values 10
Step 6. Enter Transformer Bids 10
Step 7. Analyze the Data 13
Step 8. Save the Bid Evaluation 15

2.2 Entering Information Manually Into DTCEM 15
Step 1. Start a New Bid Evaluation 15
Step 2. Select the Calculation Method 16
Step 3. Describe the Transformer Type and Size 17
Step 4. Edit the Load Characteristics (Optional) 18
Step 5. Edit the Cost Factors (Optional) 19
Step 6. Enter the A and B values 20
Step 7. Enter the Transformer Bids 20
Step 8. Analyze the Data 21
Step 9. Save the Bid Evaluation 22

CHAPTER 3. ANALYZING TRANSFORMER COSTS FOR GENERATING UTILITIES 23

3.1 Entering Information Into the DTCEM Interview 23
Step 1. Enter Utility Information 24
Step 2. Enter Financial Factors 25
Step 3. Select a Calculation Method 26
Step 4. Enter Transformer Type and Size 27
Step 5. Enter Load Characteristics 28
Step 6. Enter Cost Factors 30
Step 7. Enter Transformer Bids 32
Step 8. Analyze the Data 35
Step 9. Save the Bid Evaluation 36

3.2 Entering Information Manually Into DTCEM 36
Step 1. Start a New Bid Evaluation 37
Step 2. Select the Calculation Method 38
Step 3. Describe the Transformer Type and Size 38
Step 4. Edit the Load Characteristics 39
Step 5. Edit the Cost Factors 40
Step 6. Enter the Transformer Bids 41
Step 7. Analyze the Data 42

Step 8. Save the Bid Evaluation 44

3.3 Other Optional Features 44
Capacity Planner (GC & EC) 44
Transmission/Distribution Planner 50
RateVision 53

CHAPTER 4. ANALYZING TRANSFORMER COSTS FOR DISTRIBUTION COMPANIES AND COOPERATIVES 55

4.1 Entering Information Into the DTCEM Interview 56
Step 1. Enter Utility Information 56
Step 2. Enter Financial Factors 57
Step 3. Select a Calculation Method 58
Step 4. Enter Transformer Type and Size 59
Step 5. Enter Load Characteristics 60
Step 6. Enter Cost Factors 62
Step 7. Enter Transformer Bids 63
Step 8. Analyze the Data 66
Step 9. Save the Bid Evaluation 68

4.2 Entering Information Into DTCEM for the Calc Losses (Disco) Calculation Method 68
Step 1. Start a New Bid Evaluation 68
Step 2. Select the Calculation Method 69
Step 3. Describe the Transformer Type and Size 70
Step 4. Edit the Load Characteristics 71
Step 5. Edit the Cost Factors 72
Step 6. Enter the Transformer Bids 73
Step 7. Analyze the Data 74
Step 8. Save the Bid Evaluation 76

4.3 Entering Information Into DTCEM for the Model Losses (Disco) Calculation Method 77
Step 1. Start a New Bid Evaluation 77
Step 2. Select the Calculation Method 78
Step 3. Describe the Transformer Type and Size 79
Step 4. Edit the Load Characteristics 80
Create Default Load Schedules 81
Import RateVision Load Schedules 82
Step 5. Edit the Cost Factors 83
Step 6. Enter the Transformer Bids 85
Step 7. Analyze the Data 86
Step 8. Save the Bid Evaluation 88

4.4 Other Optional Features 89
RateVision 89
Load Schedules 89
Rate Schedules 89

CHAPTER 5. REFERENCE 90

Arrange Icons 90
Bid Evaluation Floating Toolbar 90
Bid Evaluation Templates 90
Capacity Planner (GC & EC) 90
Calculation Method 90
Cascade Windows 91
Clear All Bids 91
Close All Windows 91

Close Bid Evaluation Screen 92
Close Current Window 92
Cost Data 92
Delete Bid 93
Edit Bid 93
Exit 93
Financial Data 94
Help About 94
Help Contents 95
Help Keyword 95
Maximize Current Window 95
Minimize All Windows 95
New Bid 96
Open Bid 96
Print 96
Quick Report 96
RateVision 97
Restore All Windows 97
Save Bid 98
Save As Template 98
Set RateVision Directory 98
Summary Report 98
Tile Windows 98
Toggle Windows 98
Transformer Size and Type 99
Transformer Supplier and Price Information 99
Transmission/Distribution Planner (TD) 100
Utility Information 100

APPENDIX A: FREQUENTLY ASKED QUESTIONS 102
How can I save some of the information in the Bid Evaluation so I can use it later? 102
Why do I get different results when I open a previously saved bid evaluation file? 102
In the reports, how can I change the number of transformers I wish to purchase? 102
What are rate schedules and load schedules? 102
I am a rural distribution cooperative with a complicated rate schedule. It is impossible for me to determine the levelized demand and energy charges from this schedule. How can I save determine this information from the rate schedule such that I can use it in DTCEM? 102

APPENDIX B: TARGET EFFICIENCIES FOR DISTRIBUTION TRANSFORMERS 103
Target Efficiencies for 10 kVA Single-Phase Transformers 103
Target Efficiencies for 15 kVA Single-Phase Transformers 103
Target Efficiencies for 25 kVA Single-Phase Transformers 103
Target Efficiencies for 37.5-50 kVA Single-Phase Transformers 104
Target Efficiencies for 75 - 167 kVA Single-Phase Transformers 104

APPENDIX C: SCENARIOS FOR SIMPLE PAYBACK IN BID EVALUATION REPORT 105

APPENDIX D: GLOSSARY 106

INDEX 109

DTCEM User's Manual
Version 1.5 Beta

CHAPTER 1. INTRODUCTION

The goal of EPA's Energy Star Transformer Program is to encourage electric utilities to purchase and install high-efficiency distribution transformers where they are cost-effective. To meet this goal, the program provides state-of-the-art technical tools which assist utility efforts to cost-effectively accelerate pollution prevention.

The Distribution Transformer Cost Evaluation Model (DTCEM) is one such tool that helps electric utilities, particularly smaller utilities, perform the complex economic analyses needed to accurately determine the cost-effectiveness and emission reduction potential of high-efficiency distribution transformers. DTCEM provides the information necessary for utilities to weigh purchases of high-efficiency distribution transformers against other competing resource options.

Installing the DTCEM Software

Before you begin working with DTCEM, check the contents of your DTCEM package, make sure you have the correct equipment to run the program, and read through the rest of this section to be sure you have a clear understanding of the installation procedure.

The DTCEM Package

Your DTCEM package includes the following:

- 2 3**?** inch DTCEM program installation disks;
- DTCEM user's manual (this document);
- 3**?** inch RateVision program disk; and
- RateVision user's manual.

Required Equipment

- An IBM compatible computer with a 386SX or better processor with 4MB RAM;
- Microsoft Windows 3.1 or later; and
- Hard disk with at least 8 MB of space available.

Recommended Equipment

- ***Color monitor*** - DTCEM operates on a monochrome monitor; however, some screens are difficult to read. We suggest using a screen resolution greater than 640 x 480 (at this resolution, some parts of the screens may be cut off).
- ***Mouse*** - If you do not have a mouse, it is possible (though rather inconvenient) to use DTCEM using keyboard controls. For example, File menu options may be accessed by clicking the Alt key and the underscored letter in the menu option (e.g., to access the **File** menu, press **Alt+F**).
- ***Printer*** - You may wish to print a hard copy of DTCEM's results.

Installation Instructions

To install DTCEM on your computer, follow the instructions below:

1. Insert DTCEM installation Disk 1 into your floppy disk drive (A or B).
2. Click on the **File** menu of your **Windows Program Manager** and select **Run**.
3. Type **a:\setup** (or **b:\setup**) and click **OK**.
4. Follow the instructions during the installation process, *making sure that you select the default directory*. ***DTCEM will not be installed correctly if you modify the default drive or directory.***
5. Read the message in the instruction screen at the end of the installation process and double click on the upper left hand corner to continue.

Note: Follow the instructions in the RateVision user's manual to install the RateVision software.

Introduction

Version 1.5 Beta

To run DTCEM, double click on the DTCEM icon, or click on the File menu of the Windows Program Manager, select Run, and type c:\dtcem\dtcem.exe (or d:\dtcem\dtcem.exe or e:\dtcem\dtcem.exe, depending on where you install the DTCEM program files).

After DTCEM has loaded, it displays the "Welcome to DTCEM" screen (Figure 1). If you are a first time user, you may want to continue with the DTCEM Interview and select **Yes** in this screen. If you wish to enter the required information without the aid of the Interview, select **No** in this screen.

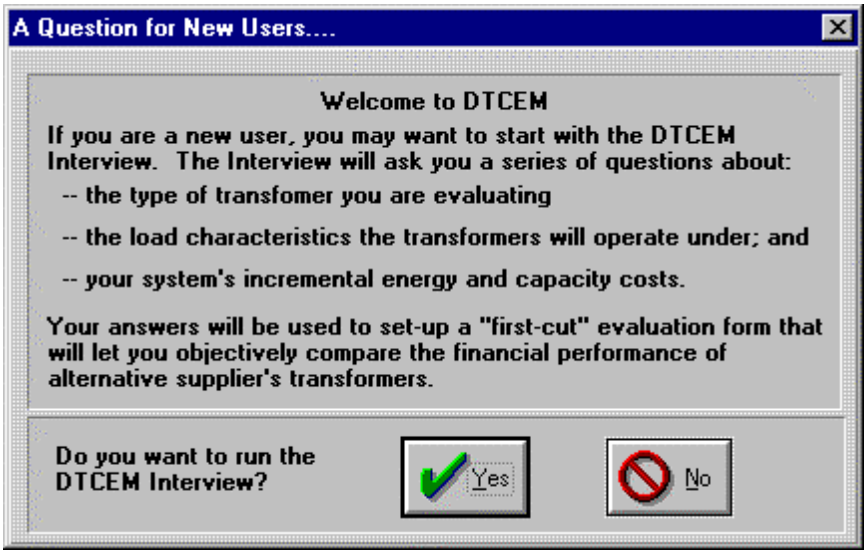


Figure 1: DTCEM welcome screen

If you have any questions regarding the above installation procedure, please call the Energy Star Hotline at **1-888-STAR-YES** (toll-free).

Primer - How to Evaluate a Transformer Bid.

Transformers are used to step down voltages. Because transformers are not 100 percent efficient, transformer losses represent a continuous source of losses to a utility or distribution company. The financial value of these losses depends upon the loss characteristics of a transformer, the characteristics of the load it is operated under, and the cost of providing electric capacity and energy. The cost-effectiveness of a new transformer purchase depends upon not only its purchase price, but also on the cost of operating it over its lifetime. DTCEM allows utilities and distribution companies to easily evaluate the cost-effectiveness of new transformer purchases.

Transformers exhibit two types of losses: **core losses** and **winding losses**. Core losses occur when the transformer is energized, even if there is no load. These losses occur because of the electrical currents and fields that magnetize the transformer core. Core losses are constant regardless of the transformer load. Winding losses, on the other hand, occur only when the transformer is loaded. Winding losses are due to the normal I^2R losses exhibited by any standard conducting material. Winding losses vary with the square of the load on the transformer. Note that core losses are also referred to as **no-load losses** and that winding losses are also referred to as **load losses**.

When a transformer bid is received, the bid typically specifies the transformer's purchase price, its core losses (in watts), and its winding losses (in watts). The basic method of transformer evaluation (for investor owned utilities) is to assign a dollar cost per watt of core losses and a dollar cost per watt of winding losses. The dollar value assigned to a watt of core losses is often referred to as the 'A' factor and the dollar value assigned to a watt of winding losses is often referred to as the 'B' factor. The overall cost of a transformer can then be expressed as:

Total Owning Cost = Purchase Price + (A * (1+ Loss Multiplier) * Core Losses) + (B * (1+ Loss Multiplier) * Winding Losses)

where: A = present value cost of a watt of core losses ($/watt)

B = present value cost of a watt of winding losses ($/watt)

The transformer purchasing process generally works as follows. After estimating the utility specific A and B factors (described below), a utility or distribution company solicits bids from interested manufacturers. The solicitation includes the specific technical specifications

required for the transformers as well as the utility's or distribution company's specific A and B factors. The prospective transformer suppliers respond by proposing their transformers that best meet the utility's or distribution company's requirements. After receiving the transformer bids from each manufacturer and checking that they meet the minimum technical specifications required (and any other requirements), each manufacturer's transformer bid can be evaluated using the formula above and the transformer with the lowest total owning cost identified. As we will see in the chapters that follow, the transformer with the lowest overall cost is not necessarily the transformer with the lowest purchase price.

In order to calculate the A and B factors, information is required on both the load characteristics the transformers will operate under and the cost of providing electrical capacity and energy. For load characteristics, this information includes the hours per year the transformer operates (HPY), the equivalent annual peak load (PL), the transformer loss Factor (LsF), and the peak responsibility factor (RF). The cost of providing electric capacity and energy depends upon the costs avoided by not having to provide a kW of capacity and by not generating a kWh of energy.

Organization of this Manual

There are four ways to enter information into the DTCEM Program. If the core and winding losses are known (from previous calculations) you should use the "Enter Losses Directly" calculation method and follow through the steps in Chapter 2 to analyze the transformer bids. If the core and winding losses are unknown, the factors will need to be calculated prior to analyzing the transformer bids. Generating utilities should use the "Calc Losses (Generator)" calculation method and follow through the steps in Chapter 3. Distribution companies and cooperatives have two choices in DTCEM for analyzing transformer bids. They may use the "Calc Losses (Disco)" calculation method which calculates the core and winding losses using direct inputs including the demand charge, energy charge, and other load information. They may conversely select the "Model Losses (Disco)" calculation method which calculates the core and winding losses from previously entered RateVision rate and load schedules. Both of these options are covered in Chapter 4.

Figure 2 summarizes this organizational structure.

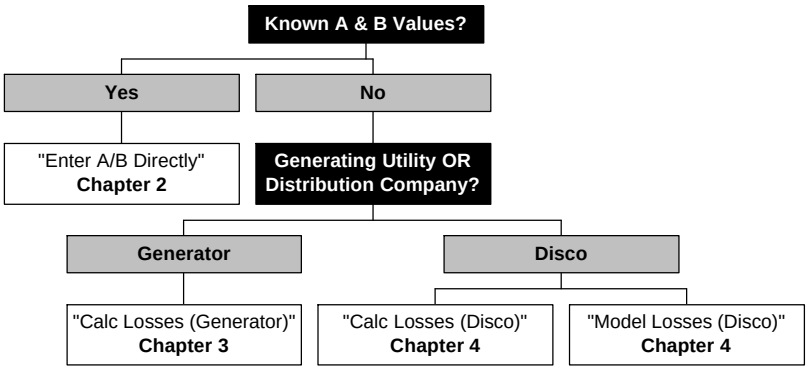


Figure 2: Organization of Manual

CHAPTER 2. ANALYZING TRANSFORMER COSTS WITH KNOWN A AND B VALUES

This chapter presents the steps needed to analyze the cost-effectiveness of the different transformer bids by using known A and B values. If these values are already known or have already been calculated, you can simply enter these values directly into the Bid Evaluation Screen.

This chapter is organized into two sections as outlined below.

Section 2.1 Presents a case study and details the steps required for using the DTCEM Interview to analyze transformer bids with known A and B values.

Section 2.2 Details the steps needed to manually enter the information needed to analyze transformer costs with known A and B values.

2.1 Entering Information Into the DTCEM Interview

This section presents a case study for an investor owned utility with known A and B factors. The steps of the DTCEM Interview are introduced to show how to enter the case study information study into the software program and identify the most cost-effective bid.

Case Study

Public Power and Light (PPL) is an investor owned utility providing power to the state of Massachusetts. PPL is looking to purchase 200 single phase dry-type transformers rated at 100 kVA, 120/240 voltage. From previous calculations, PPL determined that the A value (for core losses) is $4.25 and the B value (for winding losses) is $1.10. Use the DTCEM Interview to analyze these core and winding losses and calculate the total owning costs of the transformers based on the bids below.

Manufacturer	Bid	A	B
Manufacturer 1	$400	100 watts	418 watts
Manufacturer 2	$325	110 watts	395 watts
Manufacturer 3	$410	93 watts	387 watts
Manufacturer 4	$380	109 watts	326 watts

Start this case study by installing and running DTCEM as explained in the Installation Instructions on page 1. This case study describes entering the data through the DTCEM Interview. Upon starting the DTCEM Program you may start the interview by clicking "**Yes**" in the Welcome box. You may also start the interview by selecting **Interview** from the **Interview** menu.

The first interview screen pops up as shown in Figure 3 below:

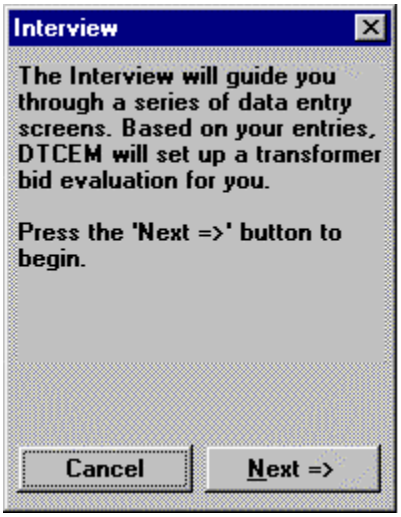


Figure 3: Interview Explanation screen

➜ ***To continue with the interview, click on the Next button.***

Step 1. Enter Utility Information

The first step is to enter the information about Public Power and Light.

➜ ***Enter "Public Power and Light" in the utility name box and select "Massachusetts" from the state pick list.***

For now, accept the default values for the emissions factors listed in the lower portion of the box (you may change these values by clicking in the appropriate white boxes, deleting the current values, and typing the correct values). Your finished "Utility Information" screen should look like Figure 4 below:

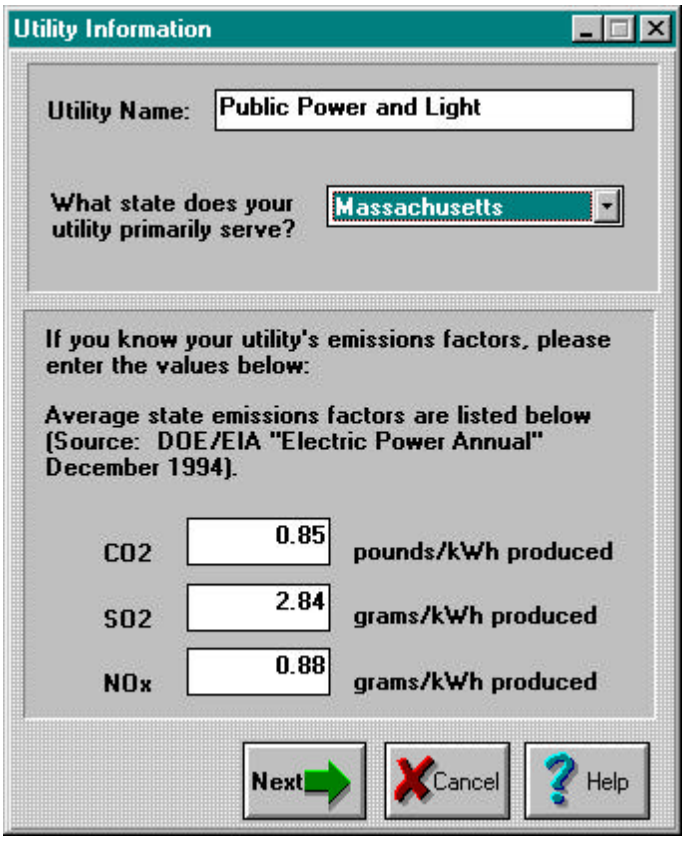


Figure 4: Public Power and Light Information

➜ ***When you are finished, click on the Next button to continue with the Interview.***

Step 2. Enter Financial Factors

The next step is to enter the financial factors which will be used in the cost and benefit calculations. For this case study we will accept the default values given in this screen for all of the financial factors. The "Enter Financial Factors" screen looks like Figure 5 below:

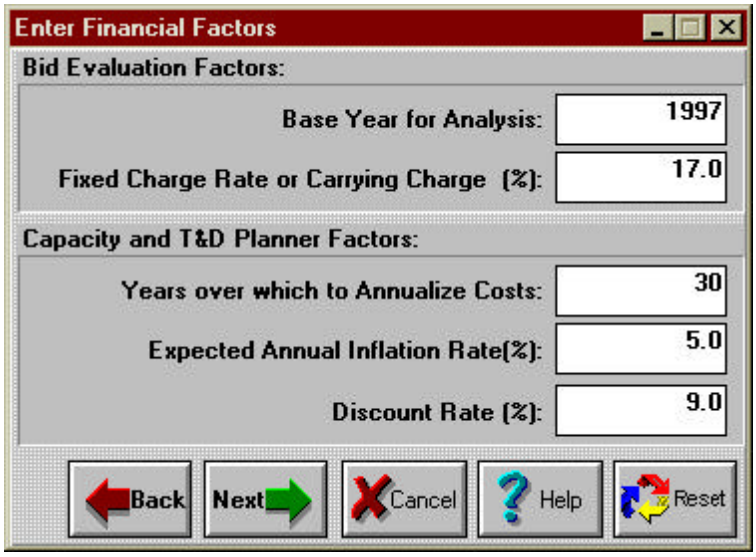


Figure 5: Financial Factors screen

This screen contains the base year for analysis, the years over which to annualize costs, the expected annual inflation rate (page 107), the discount rate (page 106), and the fixed charge rate (page 107). The annualization years, annual inflation rate, and the discount rate are used in the Capacity Planner to calculate the avoided cost of energy. The fixed charge rate is used to calculate the core and winding losses.

➜ ***Accept the defaults for these financial factors by clicking on the Next button.***

Step 3. Select a Calculation Method

The next step is to select the calculation method for estimating core and winding losses (A and B factors). You have the following four choices in this "Select the Calculation Method" screen (Figure 6):

1. Enter Losses Directly
2. Calc Losses (Generator)
3. Calc Losses (Disco)
4. Model Losses (Disco)

Since the core and winding losses for Public Power and Light have already been calculated, we want to select the "Enter Losses Directly" option.

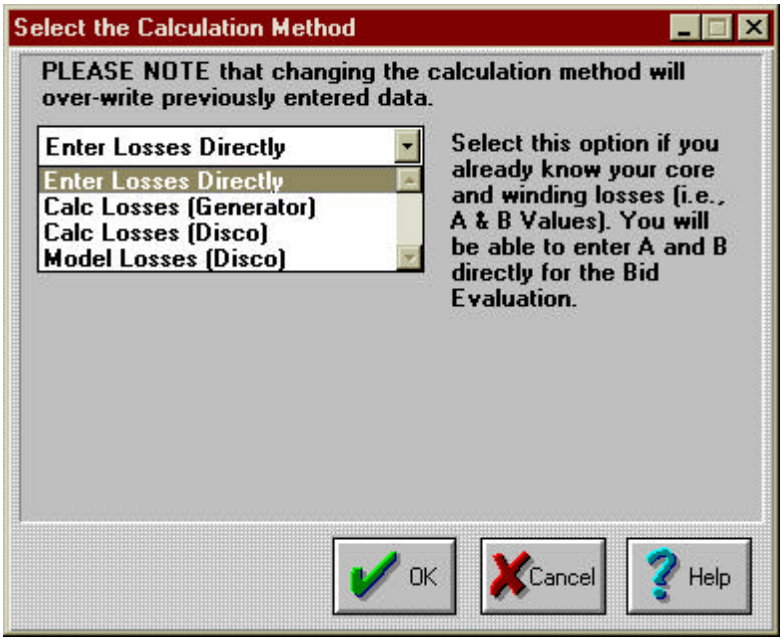


Figure 6: Calculation Method dialog box

➜ ***Select "Enter Losses Directly" from the drop down list. This selection allows you to input previously calculated A and B values without derivation of all of the parameters associated with these values.***

➜ ***Click on the Next button to continue with the interview.***

Step 4. Enter Transformer Type and Size

The next step is to enter the size and type of transformers which Public Power and Light wishes to purchase.

➜ ***Select Single Phase Dry Type from the "Transformer Type" picklist.***

➜ ***Select 100 kVA from the "Transformer Size" picklist.***

➜ ***Select 30 in the "Transformer Lifetime" picklist.***

The completed "Select Transformer Type and Size" screen should look like Figure 7 below:

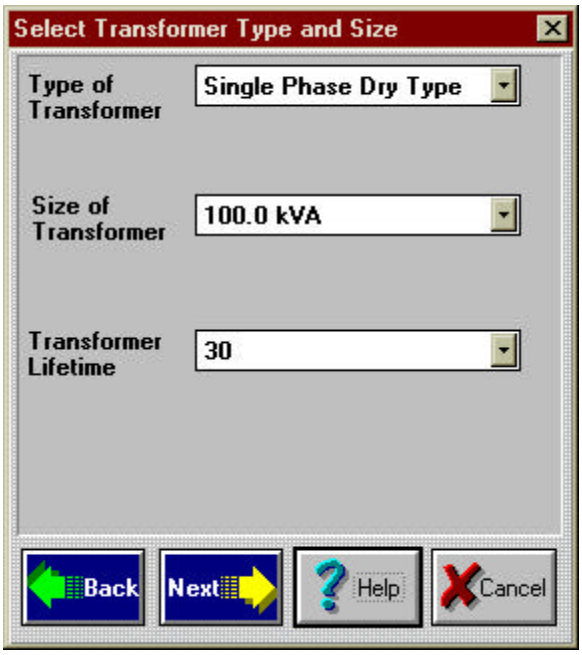


Figure 7: Public Power and Light Transformer Type and Size Dialog Box

➜ ***Click on the Next button to continue with the interview.***

Step 5. Enter A and B Values

The next step is to enter the known A and B values for Public Power and Light. As mentioned earlier, it is assumed that these values were previously calculated. It is possible to calculate these losses for a generating utility by selecting "Calc Losses (Generator)" or for a distribution company by selecting "Calc Losses (Disco)" in the Calculation Method screen. These options are discussed in more detail in Chapters 3 and 4, respectively. The "Enter A/B Values" screen is shown in Figure 8.

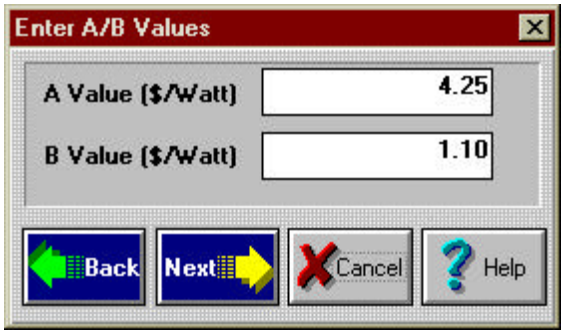


Figure 8: Enter A/B Values screen

➜ ***Enter $4.25 in the A Value box.***

➜ ***Enter $1.10 in the B Value box.***

➜ ***Continue with the interview by clicking on the "Next" button.***

Step 6. Enter Transformer Bids

The next step is to enter the bids for the transformer made by the different suppliers. You should select **Yes** in the screen as shown in Figure 9 below:

Figure 9: A Question About Bids screen

You should then select **Yes** in the screen as shown in Figure 10 below:

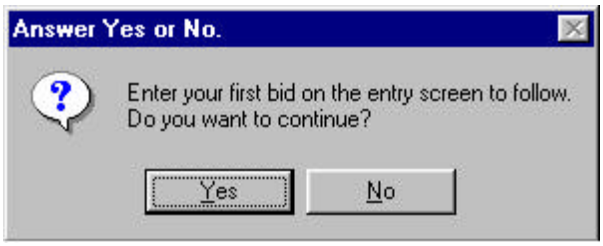


Figure 10: Answer Yes or No Screen

You should now see the "Enter a Transformer Bid" dialog box. In this screen you should enter the supplier's name, bid price, core losses, and winding losses.

➜ ***Enter "Manufacturer 1" in the Supplier Box.***

➜ ***Enter "400" in the Price Box.***

➜ ***Enter "100" in the Core Losses Box.***

➜ ***Enter "418" in the Winding Losses Box.***

The finished Transformer Dialog box should look like Figure 11.

Figure 11: Transformer Bid Dialog Box for Manufacturer 1

➜ ***Click on the OK button to continue with the interview.***

You should continue to answer **Yes** in the "Answer Yes or No" box (Figure 12) until you enter all 4 of the bids described at the top of this case study. Continue to enter the supplier's name, price, core losses, and winding losses as described above.

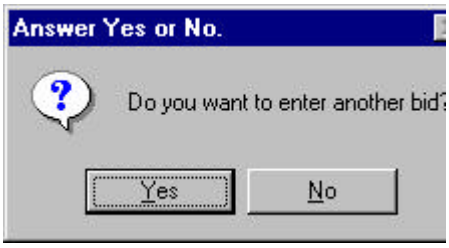


Figure 12: Answer Yes or No box

➜ ***When you have finished entering all four of the bids, click No in the "Answer Yes or No" Box.***

You have now completed the data entry portion of the case study. You should see an "All Done" box (Figure 13) indicating that you are finished.

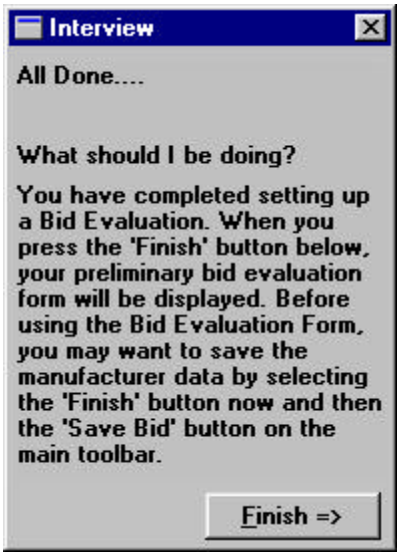
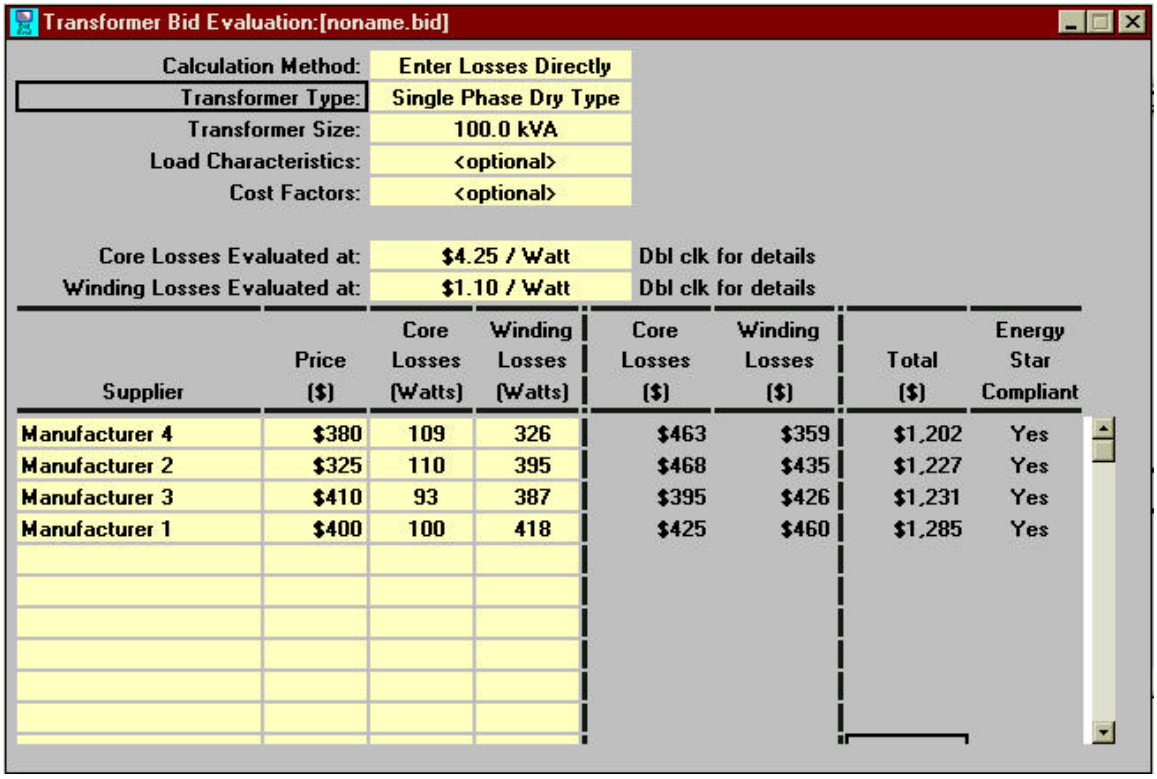


Figure 13: All Done Dialog box

➜ ***Click "Finish" to end the Interview.***

Your completed "Transformer Bid Evaluation Screen" pops up as shown in Figure 14 below.



Supplier	Price ($)	Core Losses (Watts)	Winding Losses (Watts)	Core Losses ($)	Winding Losses ($)	Total ($)	Energy Star Compliant
Manufacturer 4	$380	109	326	$463	$359	$1,202	Yes
Manufacturer 2	$325	110	395	$468	$435	$1,227	Yes
Manufacturer 3	$410	93	387	$395	$426	$1,231	Yes
Manufacturer 1	$400	100	418	$425	$460	$1,285	Yes

Figure 14: Completed Bid Evaluation Screen for Public Power and Light

As you can see, the bids are ordered from the lowest total cost to the highest. Manufacturer 4 has the lowest total cost ($1,202) while Manufacturer 1 has the highest total cost ($1,285). The total cost is calculated by using the following formula:

Total Owning Cost = (Bid Price + Cost of Core Losses + Cost of Winding Losses)

The total cost for Manufacturer 4's transformer therefore is $380 (Bid Price) + $463 (Cost of Core Losses) + $359 (Cost of Winding Losses).

Step 7. Analyze the Data

The next step is to view the comparative energy costs and benefits for the different bids in the Bid Evaluation screen.

➜ ***Click on the Quick Report icon (Figure 15) on the floating toolbar.***

You are first shown the "Report Control Panel" in which you may select the number of transformers you wish to purchase, the method by which you want to sort the transformers, the transformer bids you wish to analyze, and the transformer bid which you wish to serve as the "base case".

Figure 15: Quick Report icon

➜ ***Enter "200" in the Number of Units to Purchase box.***

➜ ***Click the "Lowest Total Owning Cost" option to sort the transformers.***

➜ ***Click the "Select All" button to select all of the bids to be analyzed.***

➜ ***Click on "Manufacturer 1" in the Bids Selected Box and then click on the "Select" button. (Assume that Public Power and Light would have purchased transformers from Manufacturer 1 before analyzing the total owning costs in DTCEM. This report compares the costs and benefits of purchasing the transformers from the other manufacturers to the costs and benefits of purchasing Manufacturer 1's transformers.)***

Your finished "Report Control Panel" should look like Figure 16 below:

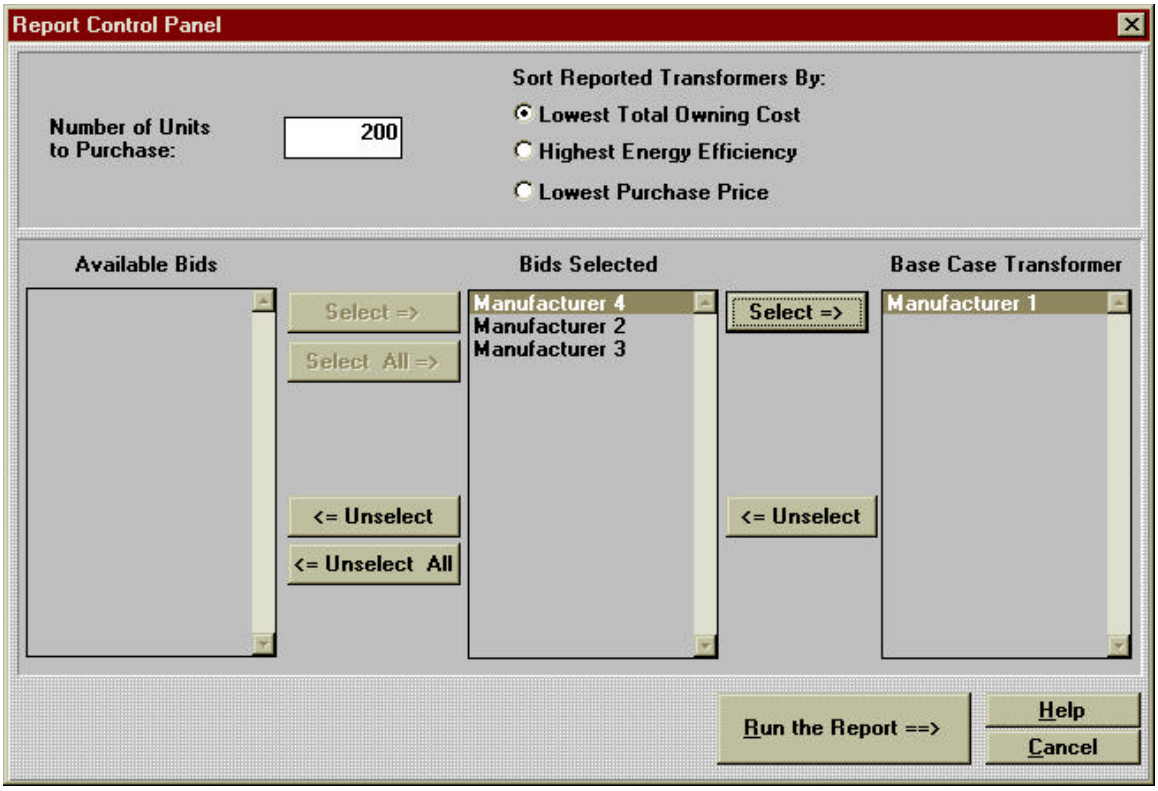


Figure 16: Report Control Panel for Public Power and Light

➜ ***Click on the "Run the Report" button to run the report.***

The "Bid Evaluation Report" pops up as shown in Figure 17.

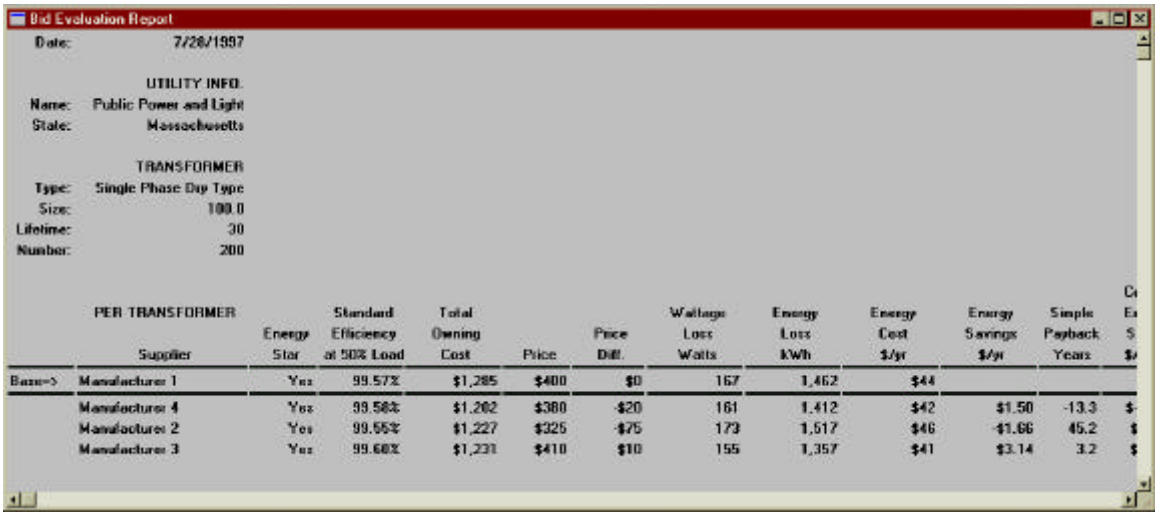


Figure 17: Public Power and Light Bid Evaluation Report

This report screen is not maximized when it is displayed. It may be necessary to use the scroll bars on the right side and the bottom of the screen to scroll through the entire report.

The top part of the report contains information about the utility and the transformers. The bottom part of the report contains two tables, both of which analyze the energy costs, benefits, and emissions avoided. These values in the top row of the table are for the "base case" transformer from Manufacturer 1. The remaining rows display values for the other transformers relative to this base case.

If we compare the costs and benefits of Manufacturer 3's transformer to the basecase (Manufacturer 1) we see that despite costing $10 more per transformer ($2,000 more for 200 transformers) Manufacturer 3's transformer will save $3.14/year in energy ($628/year for 200 transformers) and will result in a 3.2 year payback period. Though the transformers from Manufacturer 3 will cost $2,000 more in initial capital costs, over the 30 year transformer lifetime, the transformers will save $18,840 ($628/year times 30 years) when compared to the transformers from Manufacturer 1.

➜ ***Double click in the upper left hand corner of the Bid Evaluation Report to close this screen.***

It should be noted here that the simple payback may be a negative number. Simple payback is calculated by dividing the price difference by the energy savings/year. Appendix C outlines the potential scenarios and details what the simple payback in each of these cases means.

Step 8. Save the Bid Evaluation

Congratulations! You have successfully entered the information necessary to analyze transformer bids for a utility that has previously calculated A and B values. The next step is to save the file such that it can be opened and edited at a later date.

➜ ***Click on the save bid icon (Figure 18) on the toolbar.***

➜ ***Enter the name of the file in the "Select a Filename" box and click on the OK button.***

Figure 18: Save Bid icon

2.2 Entering Information Manually Into DTCEM

It may be appropriate at times to enter the information needed to analyze transformer bids with DTCEM manually, without the use of the Interview. This section details the steps needed to manually enter this information for utilities or distribution cooperatives with known A and B values.

Step 1. Start a New Bid Evaluation

The first step for manually entering information into the DTCEM Program for utilities or distribution cooperatives with known A and B values is to start a new bid evaluation. Click on the new bid icon (Figure 19) on the toolbar.

Figure 19: New bid icon

A message box (Figure 20) pops up asking you whether you want to use the default bid evaluation template or select a different bid evaluation template. Bid evaluation templates are used to start new bid evaluations. Unless you have saved a separate bid evaluation template you should select Yes in this screen. More information about bid evaluation template files is covered on page 90.

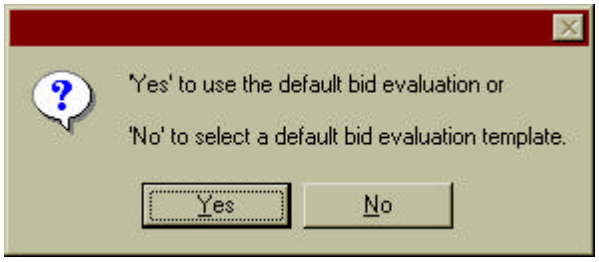


Figure 20: New Bid message box

A blank bid evaluation screen pops up as shown in Figure 21 below. *(Note that this screen may look different depending on the default template that is used to create this screen).*

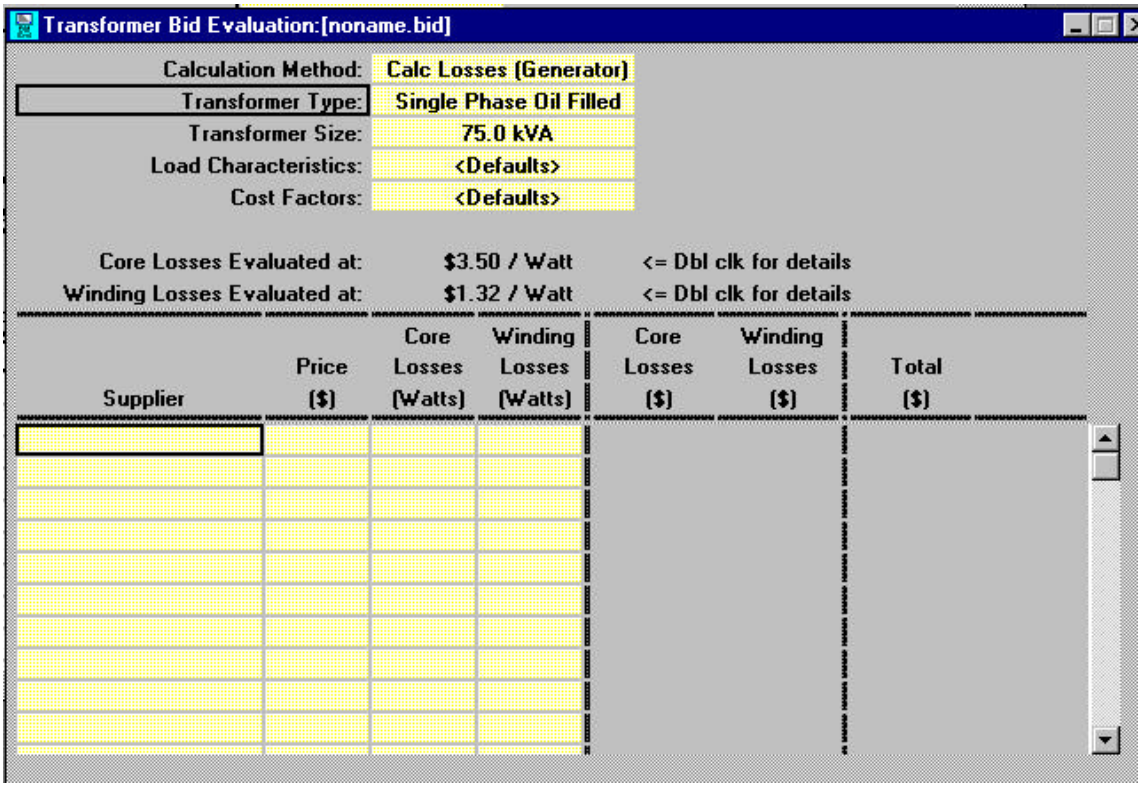


Figure 21: Blank Bid Evaluation Screen

Step 2. Select the Calculation Method

The next step is to select the calculation method that will be used to calculate the core and winding losses. Double click in the cream colored cell next to the Calculation Method text at the top of the Bid Evaluation Screen.

The "Select the Calculation Method" dialog box is presented as shown in Figure 22 below:

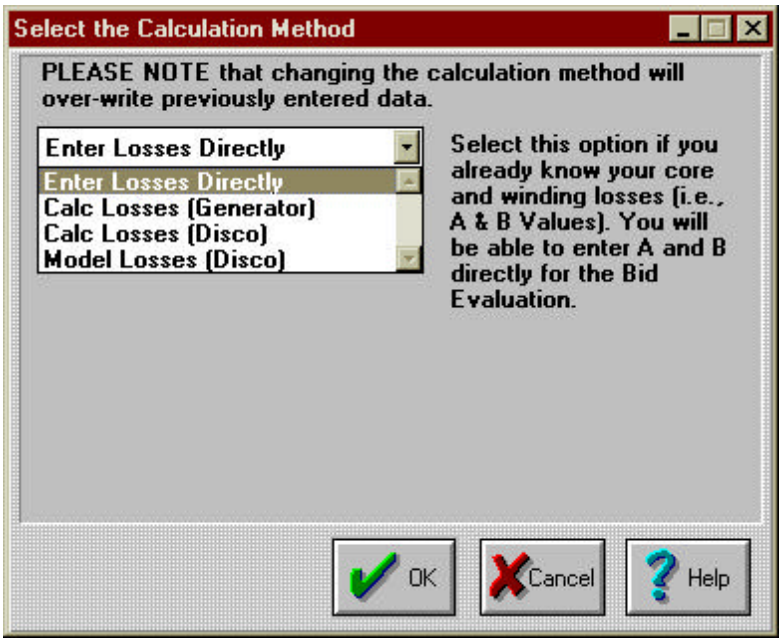


Figure 22: Select the Calculation Method dialog box

Utilities or distribution cooperatives with known A and B values should select "Enter Losses Directly" from the drop down box. Click on OK to save and continue.

Step 3. Describe the Transformer Type and Size

The next step is to enter the size and type of the transformer desired. Double click on either the **Transformer Size** or **Transformer Type** cream colored box at the top of the Bid Evaluation table. The "Select Transformer Type and Size dialog box pops up as shown in Figure 23 below:

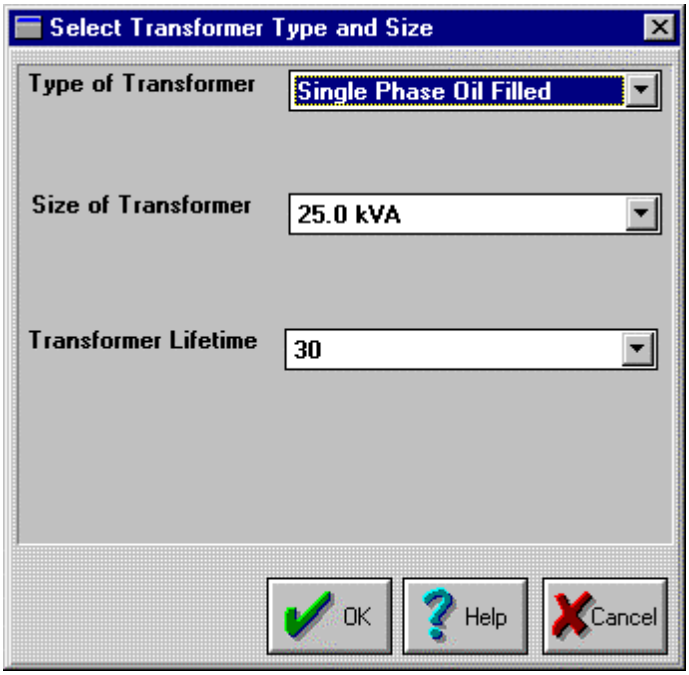


Figure 23: Select Transformer Type and Size dialog box

Three drop down lists are presented in this dialog. The top box shows the type of transformer, the middle box shows the size of the transformer in kVA, and the bottom box shows the transformer life in years. Any of the three parameters may be changed by clicking on the arrow to the right of the edit box. When you are finished, click on the OK button to exit. The changed size and type will be reflected in the Bid Evaluation screen.

Step 4. Edit the Load Characteristics (Optional)

The fourth step is optional. Based on the calculation method and the type and size of the transformer, default load characteristics are created in DTCEM. These characteristics may be edited if necessary by double clicking on the cream colored cell corresponding to the **Load Characteristics** at the top of the Bid Evaluation screen. The "Enter Load Factor and Loss Multiplier" dialog box pops up as shown in Figure 24 below.

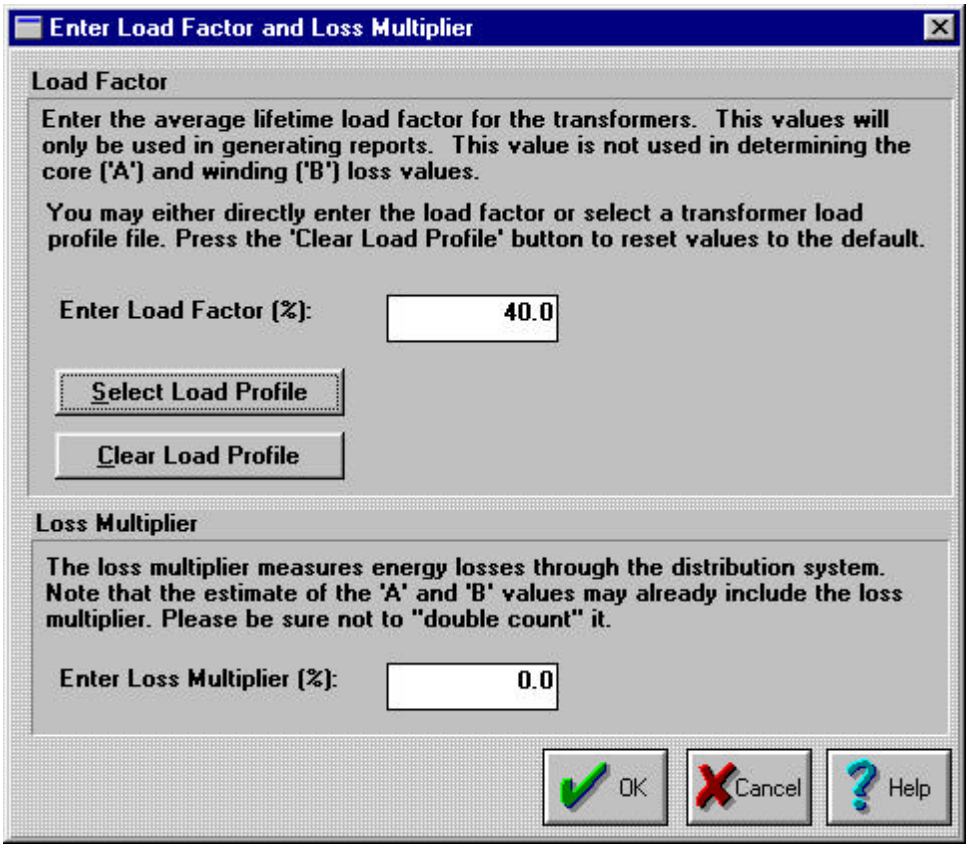


Figure 24: Load Factor and Loss Multiplier screen

The load factor (page 107) may be edited by clicking in the white box at the top of the screen and typing the new value or by importing a load profile file. The loss multiplier (page 107) may be edited by clicking in the white box at the bottom of the screen and typing the new value. Click on OK to save and continue.

Step 5. Edit the Cost Factors (Optional)

The average annual energy cost per kWh may be optionally entered for utilities or distribution cooperatives with known core and winding losses. Double click on the cream colored cell corresponding to the **Cost Factors** cell in the top of the Bid Evaluation table. The "Enter the Estimated Value of Energy Saved" box pops up as shown in Figure 25 below:

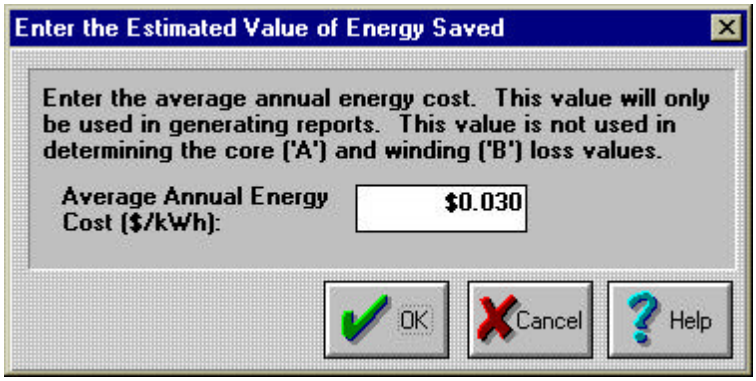


Figure 25: Estimated Value of Energy Saved

The average annual energy cost is used in generating the costs and benefits of the transformer bids. This value may be edited by clicking in the white box and typing the new value. Click on OK to save and continue.

Step 6. Enter the A and B values

The next step is to enter the A and B values for the utility or distribution company. Double click on one of the cream colored boxes corresponding either to the **Core Losses** or **Winding Losses** at the top of the Bid Evaluation screen. The "Enter A/B Values" dialog box

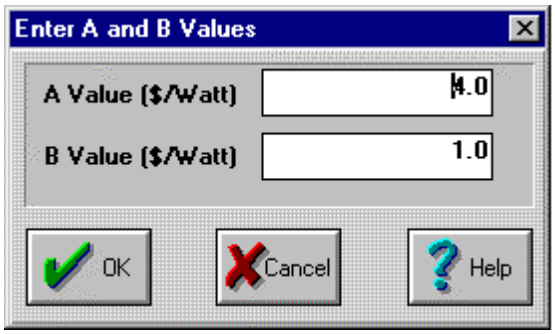


Figure 26: Enter A/B Values dialog box

pops up as shown in Figure 26 below:

Enter the correct A and B values in the white boxes. Click on OK to save and continue.

Step 7. Enter the Transformer Bids

The last required step in the manual data entry process for utilities or distribution cooperatives with known core and winding losses is to enter the transformer supplier and price information in the bottom portion of the Bid Evaluation screen. This information may be entered by double clicking in a cream colored cell in one of the rows at the bottom of the Bid Evaluation screen. The "Enter a Transformer Bid" dialog box pops up as shown in Figure 27 below:

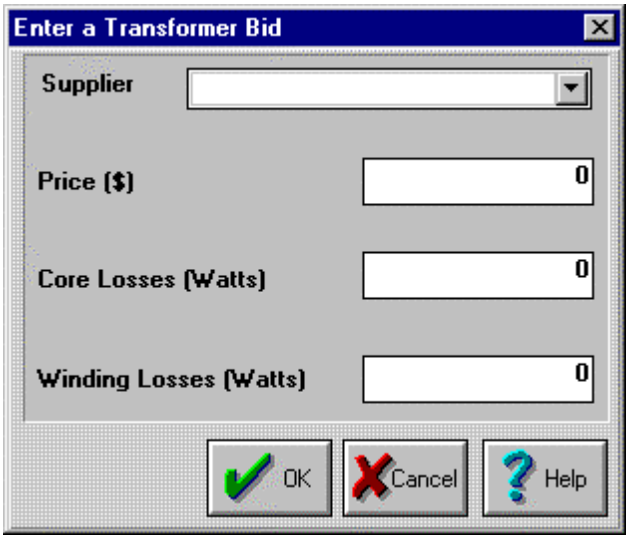


Figure 27: Enter a Transformer Bid dialog box

The information entered in this dialog is displayed in a row in the Bid Evaluation screen. The loss figures are multiplied by their appropriate incremental cost values to estimate the load loss and no-load loss costs. These values are then used to calculate the first year

losses and the lifetime losses. As the bids are added to the Bid Evaluation screen, they are ranked and listed based on the lowest total owning cost (TOC).

Step 8. Analyze the Data

The next step is to view the comparative energy costs and benefits for the different bids in the Bid Evaluation screen.

➜ ***Click on the Quick Report icon (Figure 28) on the floating toolbar.***

You are first shown the "Report Control Panel" (Figure 29) in which you may select the number of transformers you wish to purchase, the method by which you want to sort the transformers, the transformer bids you wish to analyze, and the transformer bid which you wish to serve as the "base case".

Figure 28: Quick on

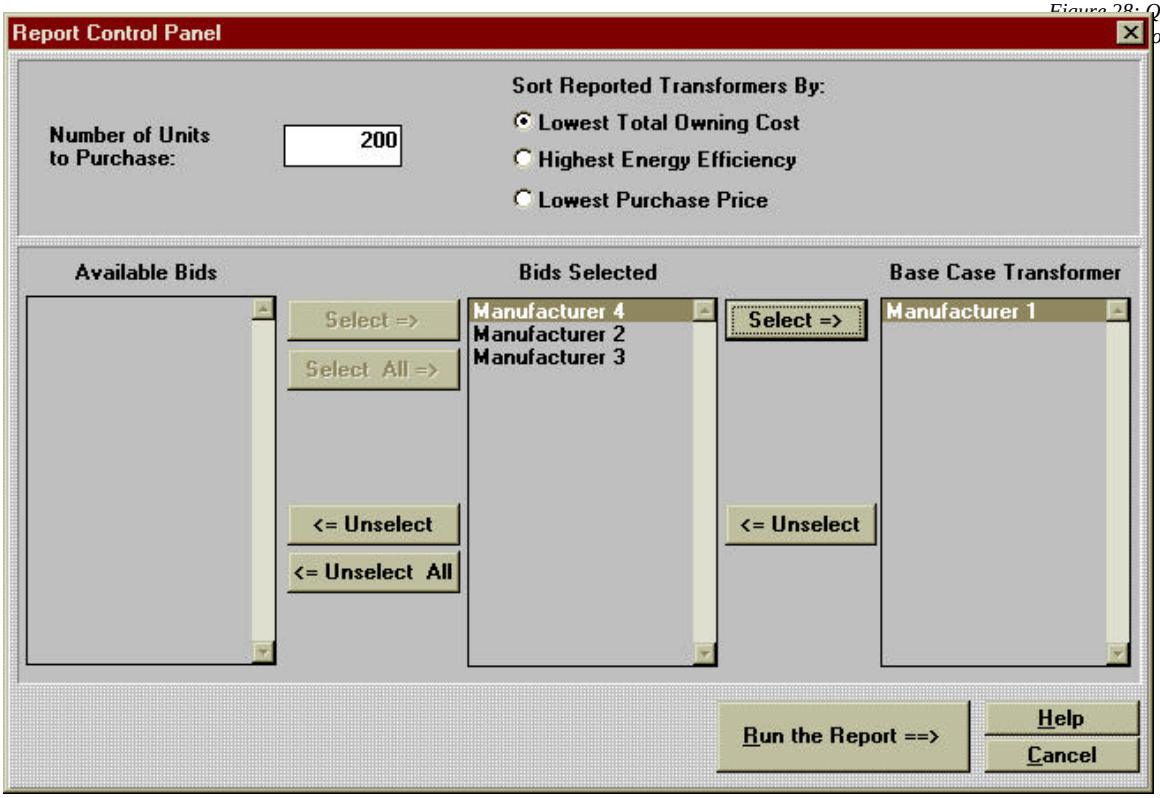


Figure 29: Report Control Panel

Enter the number of units you wish to purchase and the method by which you want to sort the transformer bids. The select the transformer bids you wish to analyze and the transformer bid which you would like to use as the "basecase". The "basecase" transformer should be the transformer you would have purchased prior to running DTCEM. When you have finished entering this information, click on the "Run the Report" button to run the report.

The "Bid Evaluation Report" pops up as shown in Figure 30.

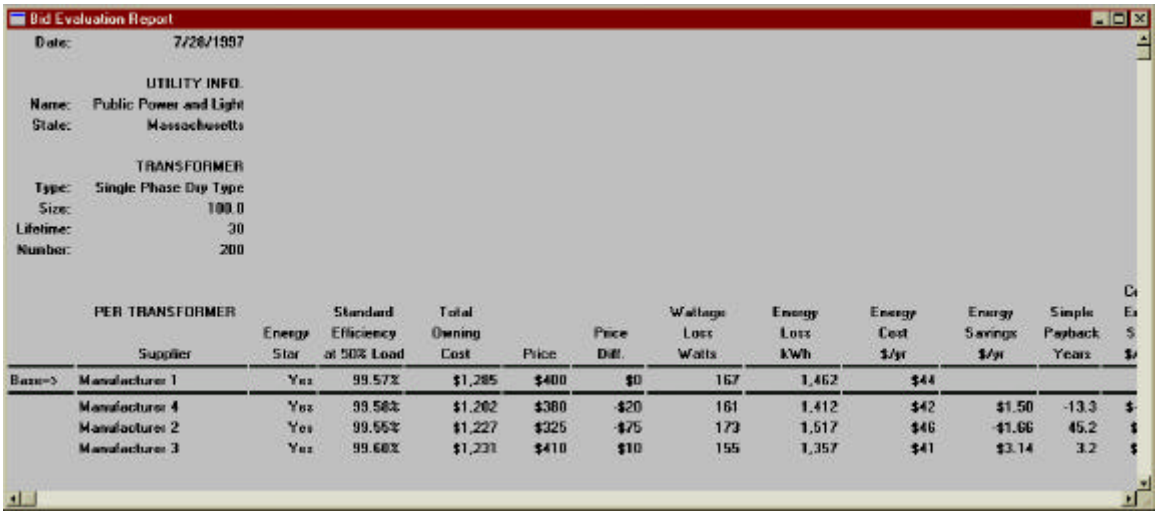


Figure 30: Bid Evaluation Report

This report screen is not maximized when it is displayed. It may be necessary to use the scroll bars on the right side and the bottom of the screen to scroll through the entire report.

The top part of the report contains information about the utility and the transformers. The bottom part of the report contains two tables, both of which analyze the energy costs, benefits, and emissions avoided. These values in the top row of the table are for the "base case" transformer. The remaining rows display values for the other transformers relative to this base case.

➜ ***Double click in the upper left hand corner of the Bid Evaluation Report to close this screen.***

It should be noted here that the simple payback may be a negative number. Simple payback is calculated by dividing the price difference by the energy savings/year. The potential scenarios and details what the simple payback in each of these cases means is detailed in Appendix C.

Step 9. Save the Bid Evaluation

After following through Steps 1 through 9 you will have successfully entered the information necessary to analyze transformer bids for a utility that has previously calculated A and B values. The next step is to save the file such that it can be opened and edited at a later date.

➜ ***Click on the save bid icon (Figure 31) on the toolbar.***

➜ ***Enter the name of the file in the "Select a Filename" box and click on the OK button.***

Figure 31: Save Bid icon

CHAPTER 3. ANALYZING TRANSFORMER COSTS FOR GENERATING UTILITIES

This chapter presents the steps needed to analyze the cost-effectiveness of the different transformer bids for utilities with unknown core and winding losses. These values may be calculated in DTCEM and used to analyze the total costs of the transformers. This requires that you enter **Load Characteristics** and **Cost Factors**. DTCEM calculates these values using the following formulae:

$$A = \frac{SC + (EC \times HPY)}{FCR \times 1000}$$

$$B = \frac{[(SC \times RF) + (EC \times LsF \times HPY)] \times PL^2}{FCR \times 1000}$$

where:

SC	=	**Avoided Cost of System Capacity**
EC	=	**Avoided Cost of Energy**
HPY	=	**Hours per year** (hours per year transformer is energized)
FCR	=	**Fixed charge rate** (cost of carrying capital on an investment)
RF	=	**Peak responsibility factor** (measure of the diversity of the load on the transformer)
LsF	=	**Transformer Loss Factor** (measure of the annual average load losses to the peak value of load losses on the distribution transformer.)
PL^2	=	**Equivalent Annual Peak Load** (levelized annual peak load seen by the transformer)

The total cost of the transformer for each supplier is then calculated using the following formula:

Total Owning Cost = (Bid Price + Cost of Core Losses + Cost of Winding Losses)

where:

Cost of Core Losses = (1.0 + Loss Multiplier) * A value * Core Losses

Cost of Winding Losses = (1.0 + Loss Multiplier) * B value * Winding Losses

This chapter is organized into three sections as described below:

Section 3.1 Presents a case study and details the steps required for using the DTCEM Interview to analyze transformer bids for utilities with unknown core and winding losses.

Section 3.2 Details the steps needed to manually enter the information needed to analyze transformer costs for utilities with unknown core and winding losses.

Section 3.3 Describes other optional features that may be used with this calculation method.

3.1 Entering Information Into the DTCEM Interview

This section presents a case study for an investor owned utility with unknown core and winding losses. The steps of the DTCEM Interview are introduced to show how to enter the case study information into the software program and identify the most cost-effective bid.

Case Study

ABC Utility is an investor owned utility providing power primarily to the state of Indiana. ABC Utility is looking to purchase 500 single phase oil filled transformers rated at 75 kVA, 120/240 voltage. Use the DTCEM Interview to calculate ABC Utility's core and winding losses (A and B factors). Upon calculating these values, you will be able to use these factors to identify the most cost effective transformer.

Assume that ABC received the following transformer bids.

Manufacturer	Bid	No-load (Core) loss	Load (Winding) loss
Manufacturer 1	$390	95 watts	413 watts
Manufacturer 2	$375	115 watts	390 watts
Manufacturer 3	$407	99 watts	385 watts
Manufacturer 4	$420	104 watts	365 watts
Manufacturer 5	$388	107 watts	410 watts
Manufacturer 6	$412	90 watts	430 watts

Start this case study by installing and running DTCEM as explained in the Installation Instructions on page 1. This case study describes entering the data through the DTCEM Interview. Upon starting the DTCEM Program you may start the interview by clicking "**Yes**" in the Welcome box. You may also start the interview by selecting **Interview** from the **Interview** menu.

The first interview screen pops up as shown in Figure 32 below:

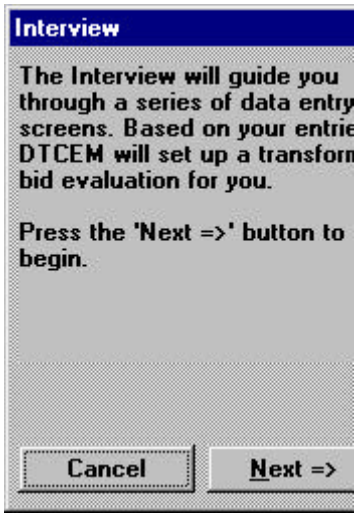


Figure 32: Interview Explanation screen

➜ ***To continue with the interview, click on the Next button.***

Step 1. Enter Utility Information

The first step is to enter the information about ABC Utility.

➜ ***Enter "ABC Utility" in the utility name box and select "Indiana" from the state pick list.***

For now, accept the default values for the emissions factors listed in the lower portion of the box (you may change these values by clicking in the appropriate white boxes, deleting the current values, and typing the correct values). Your finished "Utility Information" screen should look like Figure 33 below:

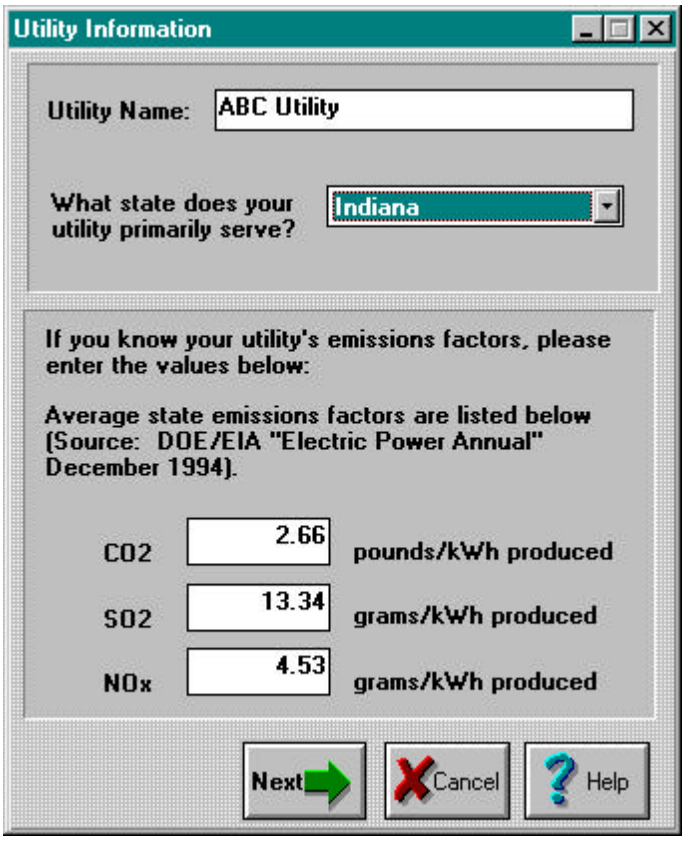


Figure 33: ABC Utility Information

➜ ***When you are finished, click on the Next button to continue with the Interview.***

Step 2. Enter Financial Factors

The next step is to enter the financial factors which will be used in the cost and benefit calculations. For this case study we will accept the default values given in this screen for all of the financial factors. The "Enter Financial Factors" screen looks like Figure 34 below:

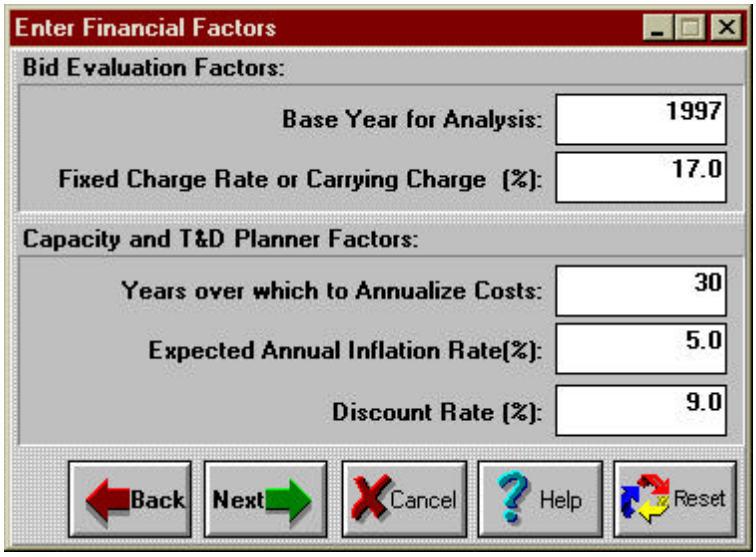


Figure 34: Financial Factors screen

This screen contains the base year for analysis, the years over which to annualize costs, the expected annual inflation rate (page 107), the discount rate (page 106), and the fixed charge rate (page 107). The annualization years, annual inflation rate, and the discount rate are used in the Capacity Planner to calculate the avoided cost of energy. The fixed charge rate is used to calculate the core and winding losses.

➜ ***Accept the defaults for these financial factors by clicking on the Next button.***

Step 3. Select a Calculation Method

The next step is to select the calculation method for estimating core and winding losses (A and B factors). You have the following three choices in this "Select the Calculation Method" screen (Figure 35):

1. Enter Losses Directly
2. Calc Losses (Generator)
3. Calc Losses (Disco)
4. Model Losses (Disco)

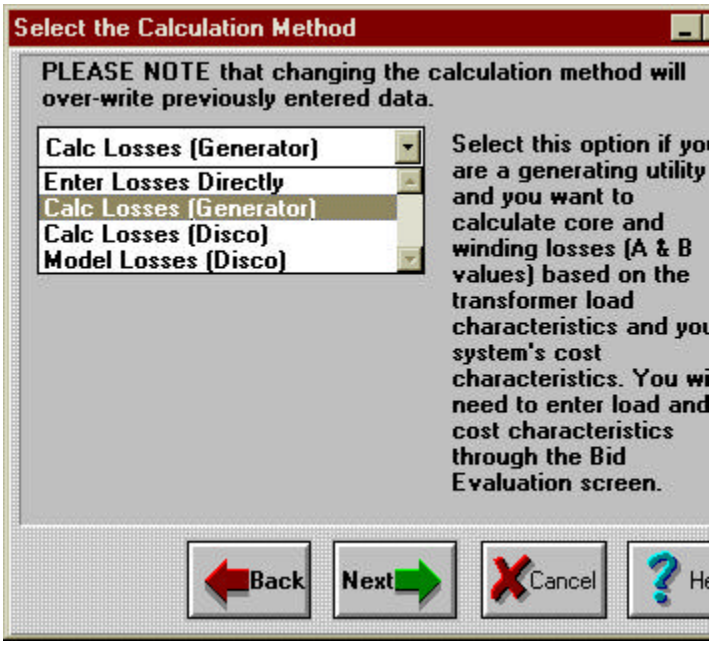


Figure 35: Calculation Method dialog box

➜ ***Since ABC Utility is a generating utility and we want to calculate the core and winding losses, select "Calc Losses***

➜ ***Click on the Next button to continue with the interview.***

Step 4. Enter Transformer Type and Size

The next step is to enter the size and type of transformer which ABC Utility wishes to purchase.

➜ ***Select Single Phase Oil Filled from the "Transformer Type" picklist.***

➜ ***Select 75 kVA from the "Transformer Size" picklist.***

➜ ***Select 30 in the "Transformer Lifetime" picklist.***

The completed "Select Transformer Type and Size" screen should look like Figure 36 below:

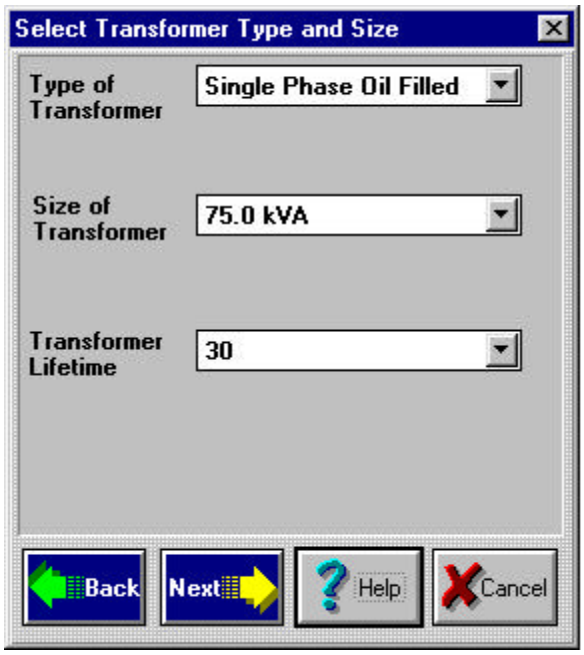


Figure 36: ABC Transformer Type and Size Dialog Box

➜ ***Click on the Next button to continue with the interview.***

Step 5. Enter Load Characteristics

The next step is to enter the load characteristics, specific to the transformer's operating load. The transformer's operating load characteristics are used to estimate the amount of energy that will be lost by the transformer over its lifetime. The "Load Characteristics" screen is shown in Figure 37.

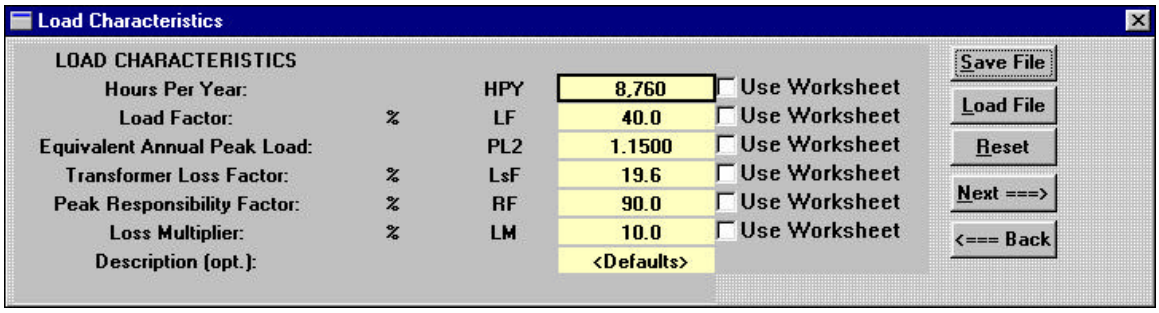


Figure 37: Load Characteristics screen

This screen includes default values for the load characteristics including:

- Hours Per Year (page 107)
- Load Factor (page 107)
- Equivalent Annual Peak Load (page 107)
- Transformer Loss Factor (page 109)
- Peak Responsibility Factor (page 108)
- Loss Multiplier (page 107)

These factors are used in the calculation of the core and winding losses (except for the load factor which is only used for reporting purposes only). The values may be entered in this screen in one of two ways. First, the values may be directly entered by clicking into the corresponding cream colored cell and typing the correct value. Alternatively, the values may be calculated by clicking on the

corresponding "Use Worksheet" box to the right of the value and entering the information needed to calculate the value in the calculation sheet at the bottom of the screen.

For ABC Utility we will calculate the value for the Equivalent Annual Peak Load (PL2) and accept the defaults for the remaining factors.

➜ ***Click in the "Use Worksheets" box next to the "Equivalent Annual Peak Load" cell.***

The Load Characteristics screen expands to show a calculation sheet with six tabs in the lower portion of the screen as shown in Figure 38. Only tabs corresponding to clicked "Use Worksheets" boxes in the upper portion of the screen are active. In this case, only the

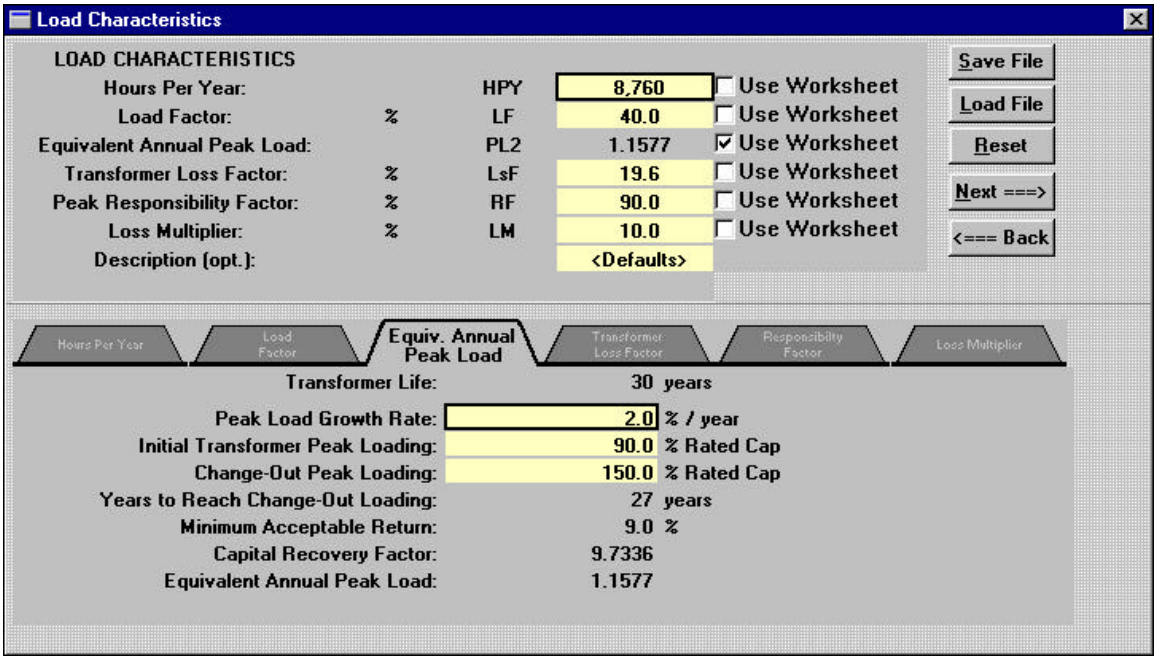


Figure 38: Equivalent Annual Peak Load Calculation Sheet in the Load Characteristics screen

In this worksheet as well as the others, cream colored cells may be edited if necessary. To change a value, simply click into the desired cell and type the more accurate number. Some calculation sheets allow you to enter information stored in files (e.g., load profile files) by double clicking on cream colored cells.

In this case study, ABC Utility expects that the initial transformer loading of the desired transformers will be 92% and the change-out peak loading will be 140%.

➜ ***Type 92 in the "Initial Transformer Peak Loading" box.***

➜ ***Type 140 in the "Change-Out Peak Loading" box.***

The Equivalent Annual Peak Load value changes to 1.1423 from a default value of 1.1577 after making these changes. These changes are reflected in both the top and bottom portion of the Load Characteristics screen as shown in Figure 39.

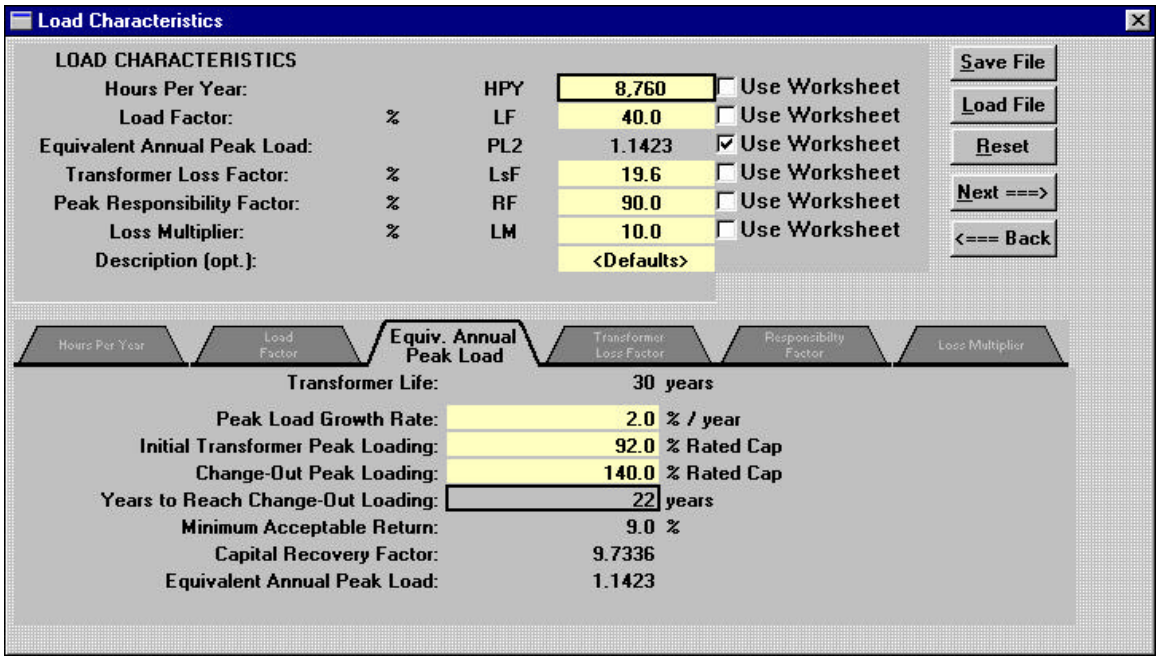


Figure 39: Changed Load Characteristics screen for ABC Utility

➜ ***Continue with the interview by clicking on the "Next" button.***

Step 6. Enter Cost Factors

The next step is to enter the costs of system capacity, energy, generation, and transmission/distribution avoided by using energy efficient transformers. The "Estimate Avoided Costs" screen is shown in Figure 40.

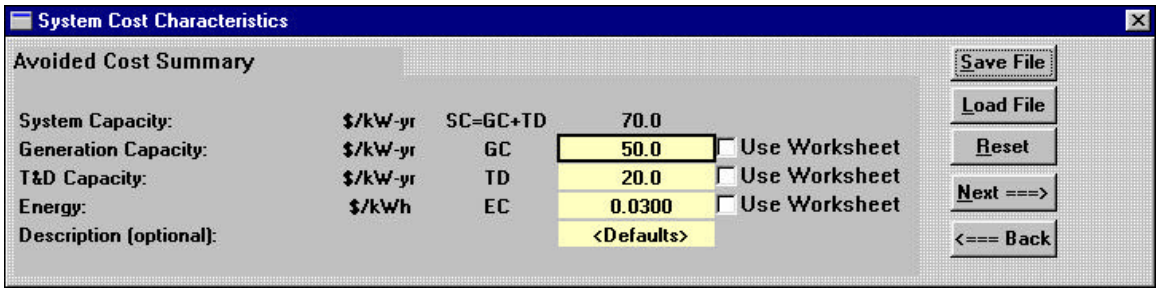


Figure 40: Cost Factors Screen

This screen includes default values for the avoided cost factors including:

- System Capacity (SC) (page 106)
- Generation Capacity (GC) (page 106)
- Transmission and Distribution (TD) (page 106)
- Energy (EC) (page 106)

These costs are used in the calculation of the value of the core and winding losses. The costs may be entered in this screen in one of two ways. First, the costs may be directly entered by clicking in the corresponding cream colored cell and typing the correct values. Alternatively, the costs may be calculated by clicking on the corresponding "Use Worksheet" box to the right of the value and entering the information needed to calculate the avoided cost in the calculation sheet at the bottom of the screen.

For ABC Utility we will calculate the values for generation capacity (GC) and energy capacity (EC).

➜ ***Click in the "Use Worksheets" box next to the "Generation Capacity" cell.***

➜ ***Click in the "Use Worksheets" box next to the "Energy" cell.***

The Cost Factors screen expands to show a calculation sheet with three tabs in the lower portion of the screen as shown in Figure 41. Only tabs corresponding to clicked "Use Worksheets" boxes in the upper portion of the screen are active. In this case, the "Generation

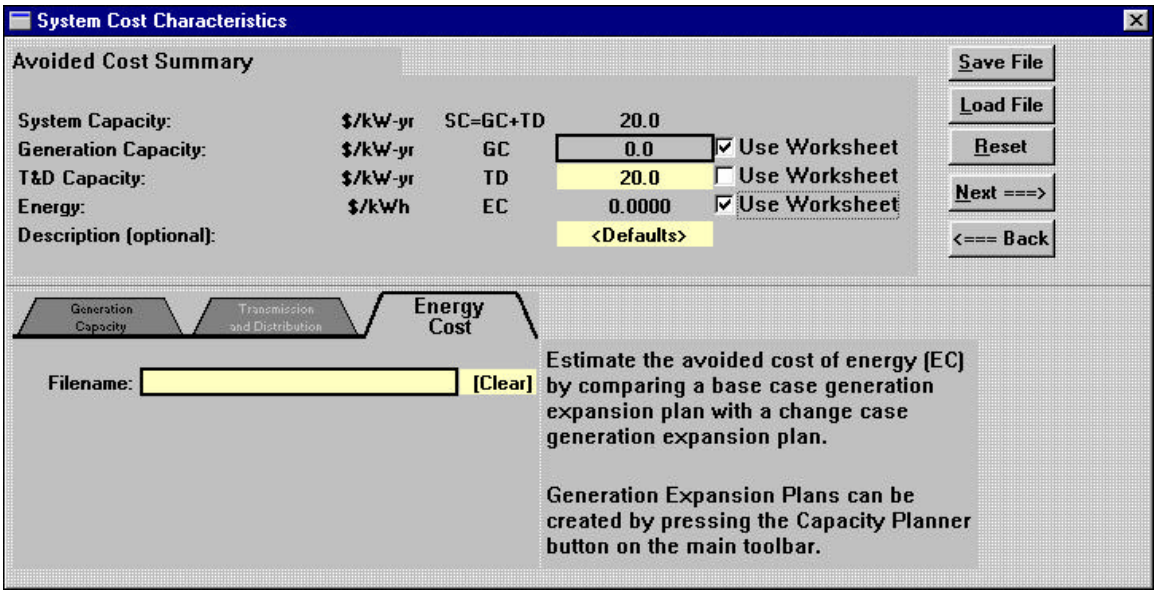


Figure 41: Expanded Cost Factors screen

In this worksheet as well as the others, cream colored cells may be edited if necessary. To change a value, simply click into the desired cell and input your utility's actual value. Some calculation sheets allow you to enter information stored in files (e.g., load profile files) by double clicking on cream colored cells.

➜ ***Click on the "Generation Capacity" tab in the calculation sheet. Double click in cream colored box next to the "Filename" box in the calculation sheet. Select basecase.cap from the file lists.***

➜ ***Click on the "Energy Cost" tab in the calculation sheet. Double click in cream colored box next to the "Filename" box in the calculation sheet. Select "basecase.cap" from the file lists.***

The Generation Capacity value changes to 82.9 from a default value of 50.0 after making these changes and the Energy Capacity value changes to 0.0312 from a default value of 0.0300. These changes are reflected in both the top and bottom portion of the Cost Factors screen as shown in Figure 42.

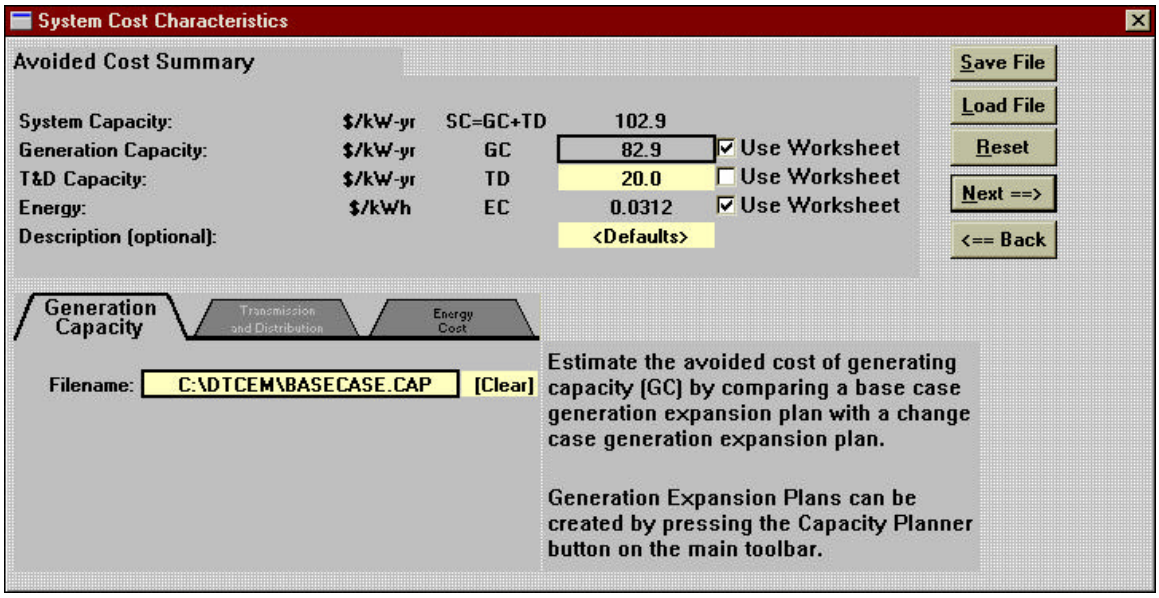


Figure 42: Changed Cost Factors Screen for ABC Utility

➜ ***Continue with this interview by clicking on the "Next" button.***

Step 7. Enter Transformer Bids

The next step is to enter the bids for the transformer made by the different suppliers. You should select **Yes** in the screen as shown in Figure 43 below:

Figure 43: A Question About Bids screen

You should then select **Yes** in the screen as shown in Figure 44 below:

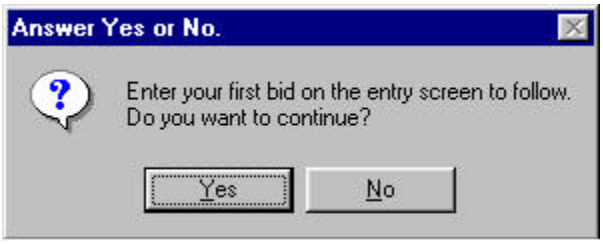


Figure 44: Answer Yes or No Screen

You will now see the "Enter a Transformer Bid" dialog box. In this screen you should enter the supplier's name, bid price, core losses, and winding losses.

➜ ***Enter "Manufacturer 1" in the Supplier Box.***

➜ ***Enter "390" in the Price Box.***

➜ ***Enter "95" in the Core Losses Box.***

➜ ***Enter "413" in the Winding Losses Box.***

The finished Transformer Dialog box should look like Figure 45.

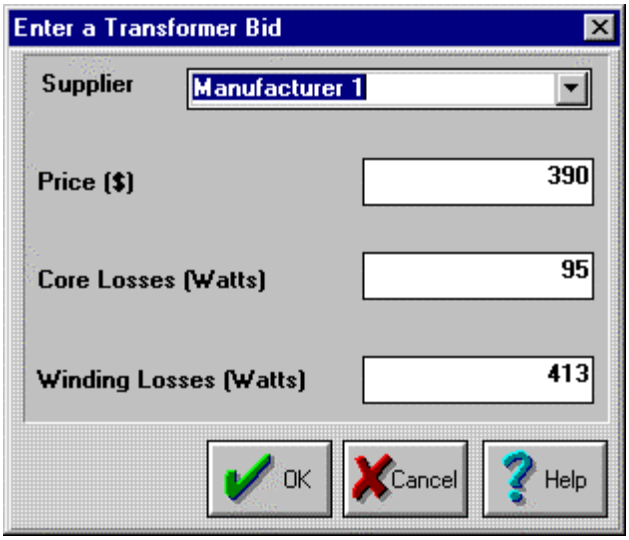


Figure 45: Transformer Bid Dialog Box for Manufacturer 1

➜ ***Click on the OK button to continue with the interview.***

You should continue to answer **Yes** in the "Answer Yes or No" box (Figure 46) until you enter all 6 of the bids described at the top of this case study. Continue to enter the supplier's name, price, core losses, and winding losses as described above.

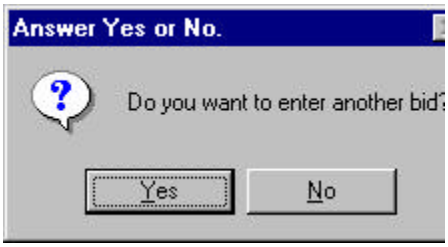


Figure 46: Answer Yes or No box

➜ ***When you have finished entering all six of the bids, click No in the "Answer Yes or No" Box.***

You have now completed the data entry portion of the case study. You should see an "All Done" box (Figure 47) indicating that you are finished.

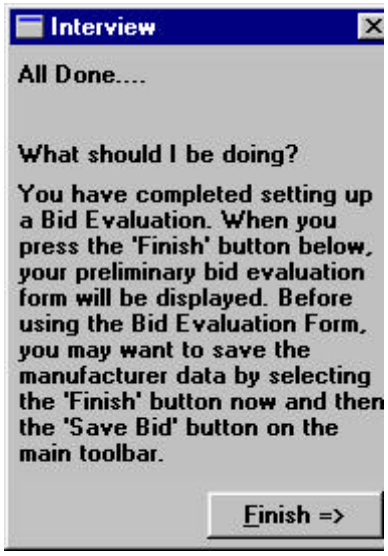


Figure 47: All Done Dialog box

➜ ***Click "Finish" to end the Interview.***

Your completed "Transformer Bid Evaluation Screen" pops up as shown in Figure 48 below.

Transformer Bid Evaluation:[noname.bid]

Calculation Method:	Calc Losses (Generator)
Transformer Type:	Single Phase Oil Filled
Transformer Size:	75.0 kVA
Load Characteristics:	<Defaults>
Cost Factors:	<Defaults>

Core Losses Evaluated at: $2.21 / Watt Dbl clk for details
Winding Losses Evaluated at: $0.98 / Watt Dbl clk for details

Supplier	Price ($)	Core Losses (Watts)	Winding Losses (Watts)	Core Losses ($)	Winding Losses ($)	Total ($)	Energy Star Compliant
Manufacturer 3	$407	99	385	$241	$416	$1,064	No
Manufacturer 1	$390	95	413	$231	$446	$1,068	No
Manufacturer 4	$420	104	365	$253	$394	$1,068	No
Manufacturer 2	$375	115	390	$280	$421	$1,076	No
Manufacturer 5	$388	107	410	$261	$443	$1,092	No
Manufacturer 6	$412	90	430	$219	$465	$1,096	No

Figure 48: Completed Bid Evaluation Screen for ABC Utility

As you can see, the bids are ordered from the lowest total cost to the highest. Manufacturer 3 has the lowest total cost despite having the fourth highest bid price. The total cost is calculated by using the following formula:

Total Owning Cost = Bid Price + Cost of Core Losses + Cost of Winding Losses

Step 8. Analyze the Data

The next step is to view the comparative energy costs and benefits for the different bids in the Bid Evaluation screen.

➜ ***Click on the Quick Report icon (Figure 49) on the floating toolbar.***

You are first shown the "Report Control Panel" in which you may select the number of transformers you wish to purchase, the method by which you want to sort the transformers, the transformer bids you wish to analyze, and the transformer bid which you wish to serve as the "base case".

Figure 49: Quick Report icon

➜ ***Enter "500" in the Number of Units to Purchase box.***

➜ ***Click the "Lowest Total Owning Cost" option to sort the transformers.***

➜ ***Click the "Select All" button to select all of the bids to be analyzed.***

➜ ***Click on "Manufacturer 5" in the Bids Selected Box and then click on the "Select" button. (Assume that you would have purchased transformers from Manufacturer 5 before analyzing the total owning costs in DTCEM. This report will compare the costs and benefits of purchasing the transformers from the other manufacturers to the costs and benefits of purchasing Manufacturer 5's transformers.)***

Your finished "Report Control Panel" should look like Figure 50 below:

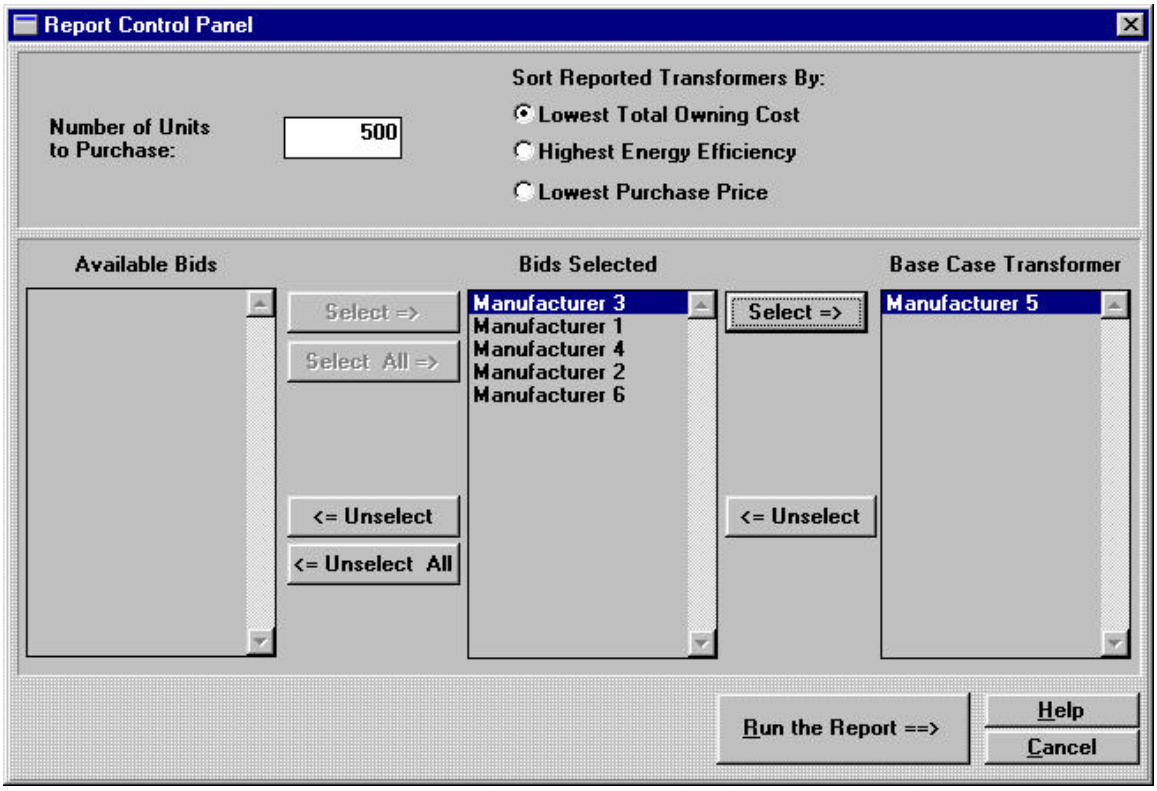
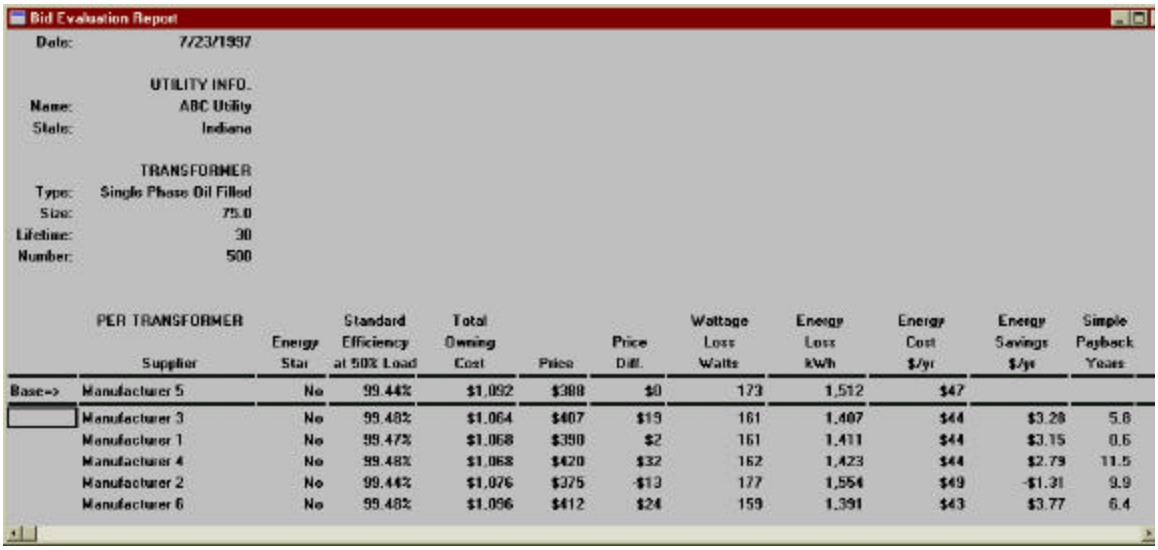


Figure 50: Report Control Panel for ABC Utility

➜ ***Click on the "Run the Report" button to run the report.***

The "Bid Evaluation Report" pops up as shown in Figure 51.



Bid Evaluation Report

Date: 7/23/1997

UTILITY INFO.
Name: ABC Utility
State: Indiana

TRANSFORMER
Type: Single Phase Oil Filled
Size: 75.0
Lifetime: 30
Number: 500

	PER TRANSFORMER Supplier	Energy Star	Standard Efficiency at 50% Load	Total Owning Cost	Price	Price Diff.	Wattage Loss Watts	Energy Loss kWh	Energy Cost $/yr	Energy Savings $/yr	Simple Payback Years
Base=>	Manufacturer 5	No	99.44%	$1,092	$388	$0	173	1,512	$47		
	Manufacturer 3	No	99.48%	$1,064	$407	$19	161	1,407	$44	$3.28	5.8
	Manufacturer 1	No	99.47%	$1,068	$390	$2	161	1,411	$44	$3.15	0.6
	Manufacturer 4	No	99.48%	$1,068	$420	$32	162	1,423	$44	$2.79	11.5
	Manufacturer 2	No	99.44%	$1,076	$375	-$13	177	1,554	$49	-$1.31	9.9
	Manufacturer 6	No	99.48%	$1,096	$412	$24	159	1,391	$43	$3.77	6.4

Figure 51: ABC Utility Bid Evaluation Report

This report screen is not maximized when it is displayed. It may be necessary to use the scroll bars on the right side and the bottom of the screen to scroll through the entire report.

The top part of the report contains information about the utility and the transformers. The bottom part of the report contains two tables, both of which analyze the energy costs, benefits, and emissions avoided. These values in the top row of the table are for the "base case" transformer from Manufacturer 5. The remaining rows display values for the other transformers relative to this base case.

If we compare the costs and benefits of Manufacturer 3's transformer to the basecase (Manufacturer 5) we see that despite costing $19 more per transformer ($9,500 more for 500 transformers) Manufacturer 3's transformer will save $3.28/year in energy ($1,640/year for 500 transformers)and will result in a 5.8 year payback period. Though the transformers from Manufacturer 3 will cost $9,500 more in initial capital costs, over the 30 year transformer lifetime, the transformers will save $49,200 ($1,640/year times 30 years) when compared to the transformers from Manufacturer 5.

➜ ***Double click in the upper left hand corner of the Bid Evaluation Report to close this screen.***

It should be noted here that the simple payback may be a negative number. Simple payback is calculated by dividing the price difference by the energy savings/year. Appendix C outlines the potential scenarios and details what the simple payback in each of these cases means.

Step 9. Save the Bid Evaluation

Congratulations! You have successfully entered the information necessary to analyze transformer bids for a utility that has previously calculated A and B values. The next step is to save the file such that it can be opened and edited at a later date.

➜ ***Click on the save bid icon (Figure 52) on the toolbar.***

➜ ***Enter the name of the file in the "Select a Filename" box and click on the OK button.***

Figure 52: Save Bid icon

3.2 Entering Information Manually Into DTCEM

It may be appropriate at times to enter the information needed to analyze transformer bids with DTCEM manually, without the use of the Interview. This section details the steps needed to manually enter this information for utilities with unknown core and winding losses.

Step 1. Start a New Bid Evaluation

The first step for manually entering information into the DTCEM Program for utilities or distribution cooperatives with known core and winding losses is to start a new bid evaluation. Click on the new bid icon (Figure 53) on the toolbar.

Figure 53: New bid icon

A message box (Figure 54) pops up asking you whether you want to use the default bid evaluation template or select a different bid evaluation template. Bid evaluation templates are used to start new bid evaluations. Unless you have saved a separate bid evaluation template you should select Yes in this screen. More information about bid evaluation template files is covered on page 90.

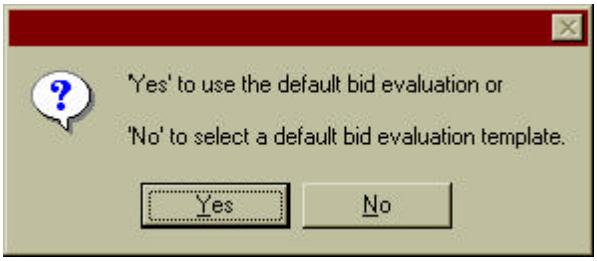


Figure 54: New Bid message box

A blank bid evaluation screen pops up as shown in Figure 55 below. *(Note that this screen may look different depending on the default template that is used to create this screen).*

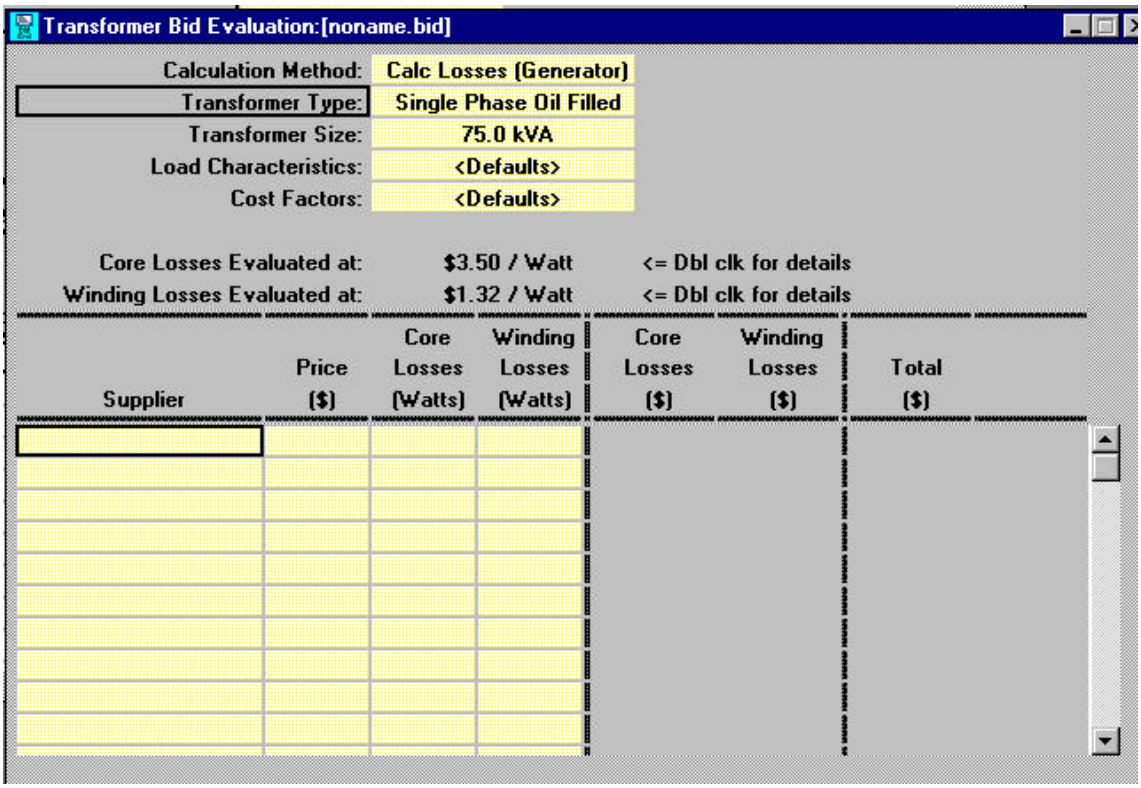


Figure 55: Blank Bid Evaluation Screen

Step 2. Select the Calculation Method

The next step is to select the calculation method that will be used to calculate the core and winding losses. Double click in the cream colored cell next to the Calculation Method text at the top of the Bid Evaluation Screen.

The "Select the Calculation Method" dialog box is presented as shown in Figure 56 below:

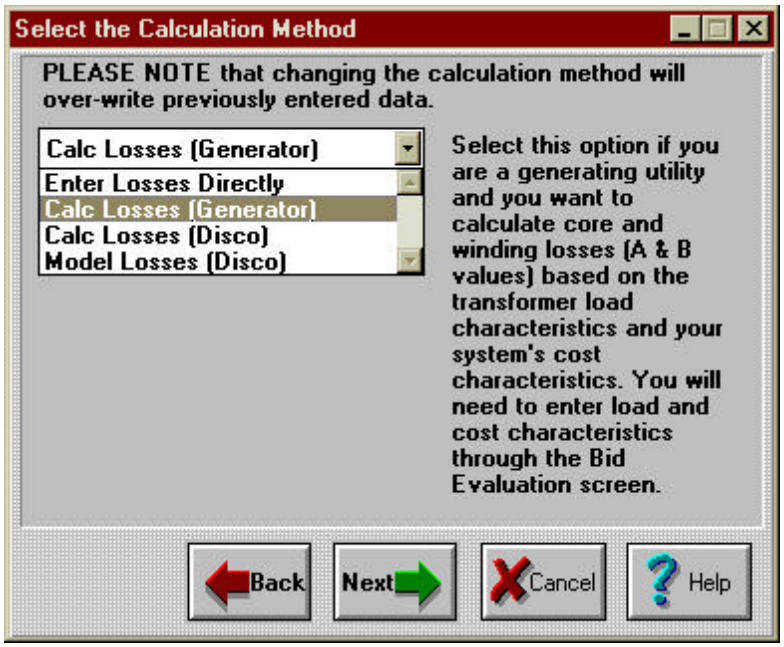


Figure 56: Select the Calculation Method dialog box

Utilities with unknown core and winding losses should select "Calc Losses (Generator)" from the drop down box. Click on OK to save and continue.

Step 3. Describe the Transformer Type and Size

The next step is to enter the size and type of the transformer desired. Double click on either the **Transformer Size** or **Transformer Type** cream colored box at the top of the Bid Evaluation table. The "Select Transformer Type and Size dialog box pops up as shown in Figure 57 below:

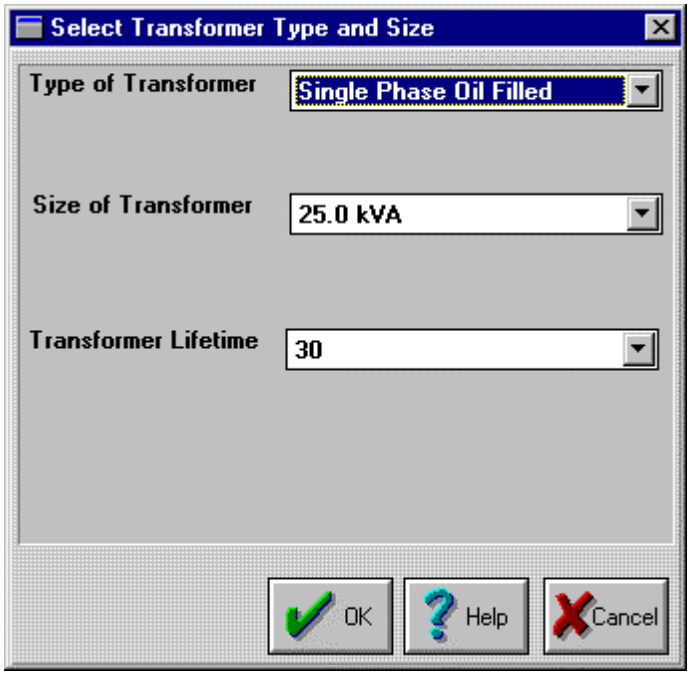


Figure 57: Select Transformer Type and Size dialog box

Three drop down lists are presented in this dialog. The top box shows the type of transformer, the middle box shows the size of the transformer in kVA, and the bottom box shows the transformer life in years. Any of the three parameters may be changed by clicking on the arrow to the right of the edit box. When you are finished, click on the OK button to exit. The changed size and type will be reflected in the Bid Evaluation screen.

Step 4. Edit the Load Characteristics

The fourth step is to edit the default load characteristics are created in DTCEM based on the calculation method and the type and size of the transformer. These characteristics may be edited by double clicking on the cream colored cell corresponding to the **Load Characteristics** at the top of the Bid Evaluation screen. The "Load Characteristics" box pops up as shown in Figure 58 below.

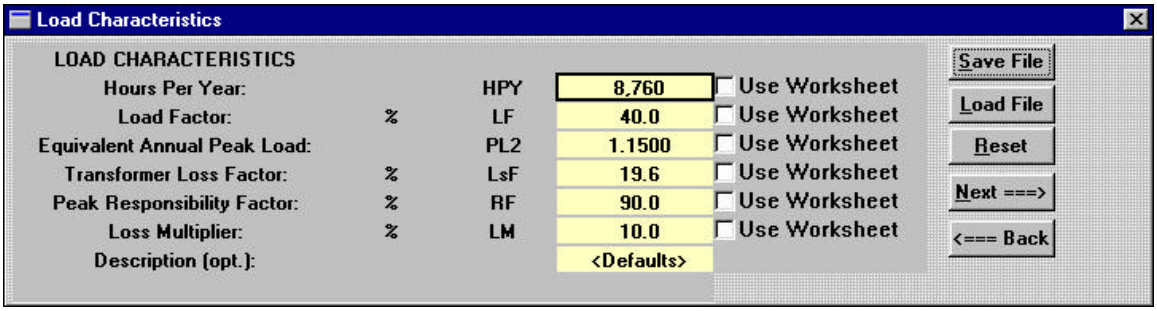


Figure 58: Load Characteristics Box

The load characteristics box contains the transformer's operating load characteristics. There are six different parameters in this screen:

- Hours Per Year (page 107)
- Load Factor (page 107)
- Equivalent Annual Peak Load (page 107)
- Transformer Loss Factor (page 109)
- Peak Responsibility Factor (page 108)

- Loss Multiplier (page 107)

In addition to these parameters, a description of the load characteristics may be entered in the Description box.

These factors may be entered directly in the cream colored box by clicking in the box and typing the correct value. The factors may also be calculated by using worksheets. To calculate a factor, click on the corresponding "Use Worksheets" box to the right of the cream colored box. A calculation sheet with six tabs is created in the lower portion of the screen as shown in Figure 59. Only tabs corresponding to clicked "Use Worksheets" boxes in the upper portion of the screen are active. While in a calculation sheet, any of the values in the cream colored boxes may be changed. Changed values are reflected in the upper portion of the "Load Characteristics" screen.

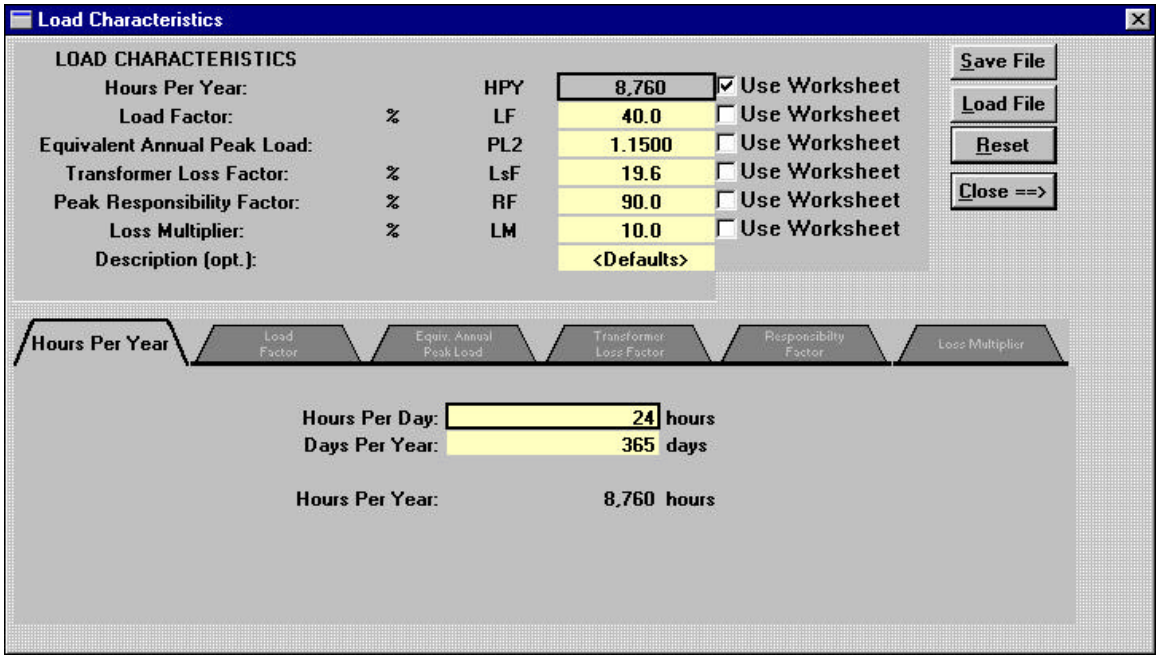


Figure 59: Expanded Load Characteristics screen

This screen may be closed by clicking on the Close button.

Step 5. Edit the Cost Factors

The next step is to enter the avoided costs of capacity and energy which are used to calculate the A and B values.. These costs may be edited by double clicking on the cream colored cell corresponding to the **Cost Factors** at the top of the Bid Evaluation screen. The "Cost Factors" box pops up as shown in Figure 60 below.

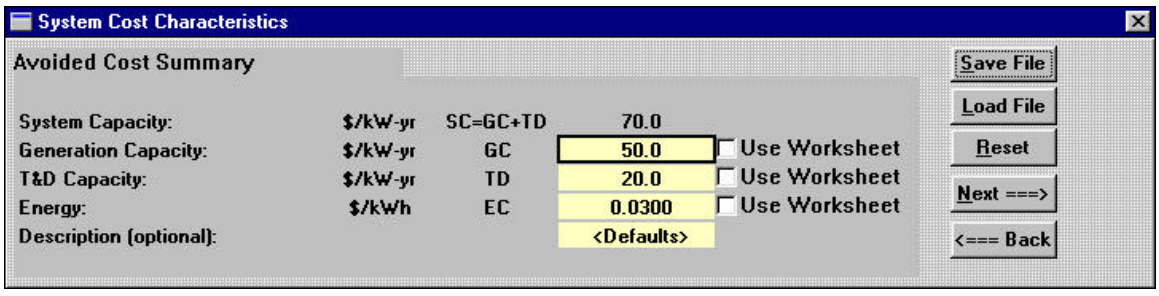


Figure 60: Cost Factors screen for the TOC Method

The following types of avoided costs may be entered and edited:

- Avoided Cost of System Capacity (SC) (page 106)
- Avoided Cost of Generation Capacity (GC) (page 106)
- Avoided Cost of T&D Capacity (TD) (page 106)
- Avoided Cost of Energy (EC) (page 106)

The values for GC, TD, and EC may be entered directly by clicking in the corresponding box and typing the accurate value. The factors may also be calculated by using worksheets. To access a calculation worksheet for either GC, TD, or EC, click in the corresponding "Use Worksheet" check box to the right of the value. The "Estimate Avoided Costs" screen expands exposing a lower section with tabulated tables corresponding to the GC, TD, and EC values in the Avoided Cost Summary table as shown in Figure 61. Only tabs corresponding to clicked "Use Worksheets" boxes in the upper portion of the screen are active.

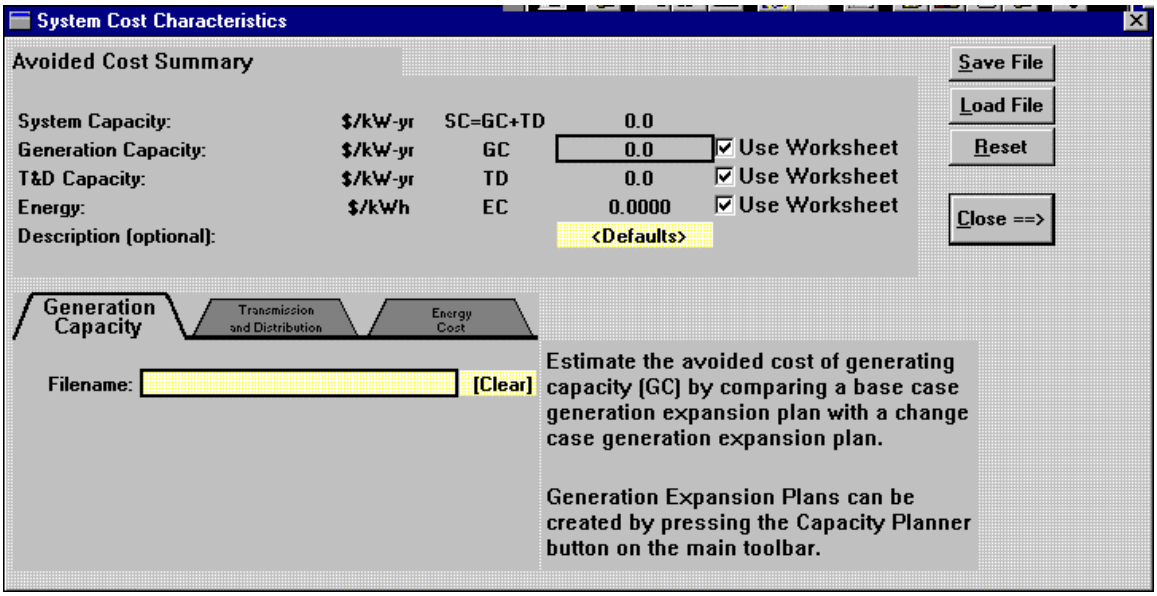


Figure 61: Estimate Avoided Costs Using Worksheets screen

This screen may be closed by clicking on the Close button.

Step 6. Enter the Transformer Bids

The last required step in the manual data entry process for utilities with unknown core and winding losses is to enter the transformer supplier and price information in the bottom portion of the Bid Evaluation screen. This information may be entered by double clicking in a cream colored cell in one of the rows at the bottom of the Bid Evaluation screen. The "Enter a Transformer Bid" dialog box pops up as shown in Figure 62 below:

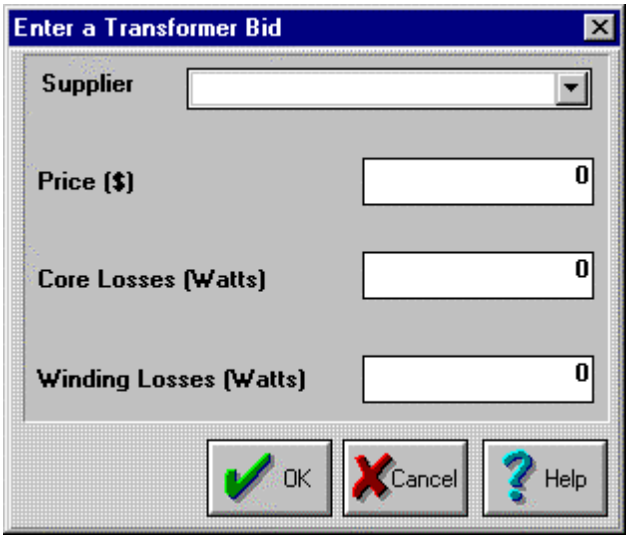


Figure 62: Enter a Transformer Bid dialog box

The information entered in this dialog is displayed in a row in the Bid Evaluation screen. The loss figures are multiplied by their appropriate incremental cost values to estimate the load loss and no-load loss costs. These values are then used to calculate the first year losses and the lifetime losses. As the bids are added to the Bid Evaluation screen, they are ranked and listed based on the lowest total owning cost (TOC).

Step 7. Analyze the Data

The next step is to view the comparative energy costs and benefits for the different bids in the Bid Evaluation screen.

➜ ***Click on the Quick Report icon (Figure 63) on the floating toolbar.***

You are first shown the "Report Control Panel" (Figure 64) in which you may select the number of transformers you wish to purchase, the method by which you want to sort the transformers, the transformer bids you wish to analyze, and the transformer bid which you wish to serve as the "base case".

Figure 63: Quick Report icon

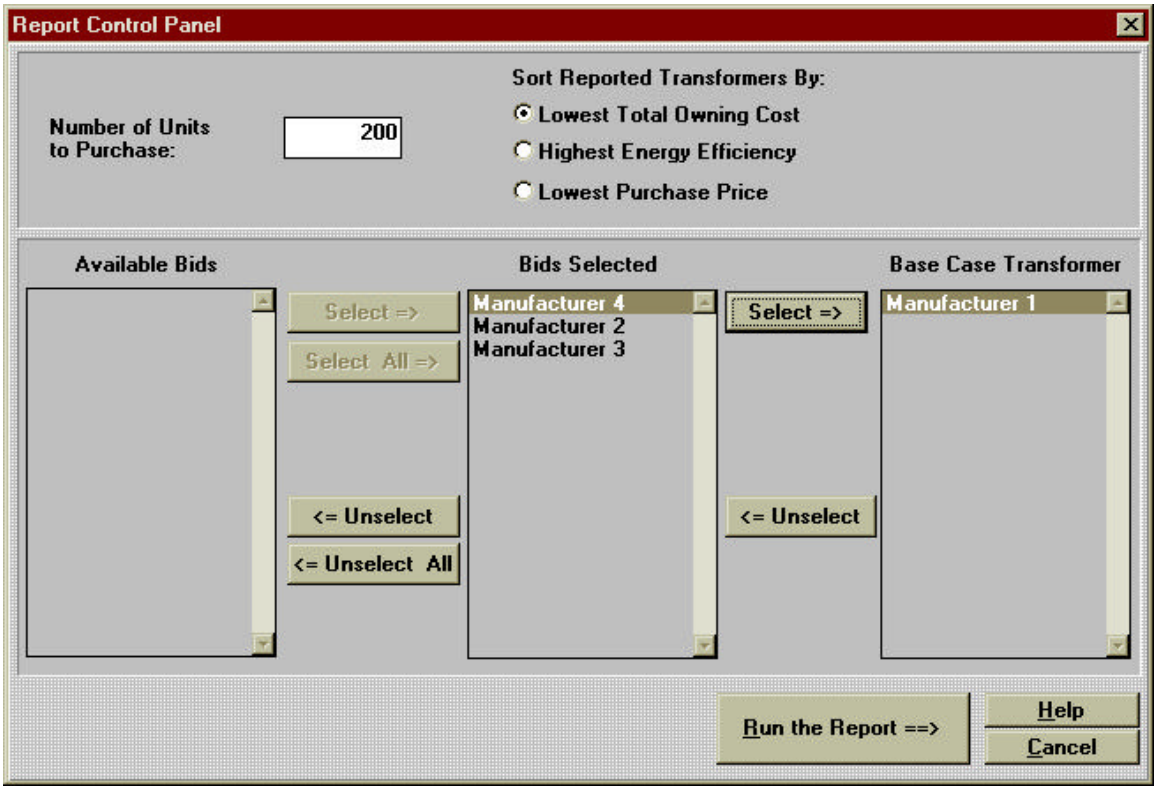
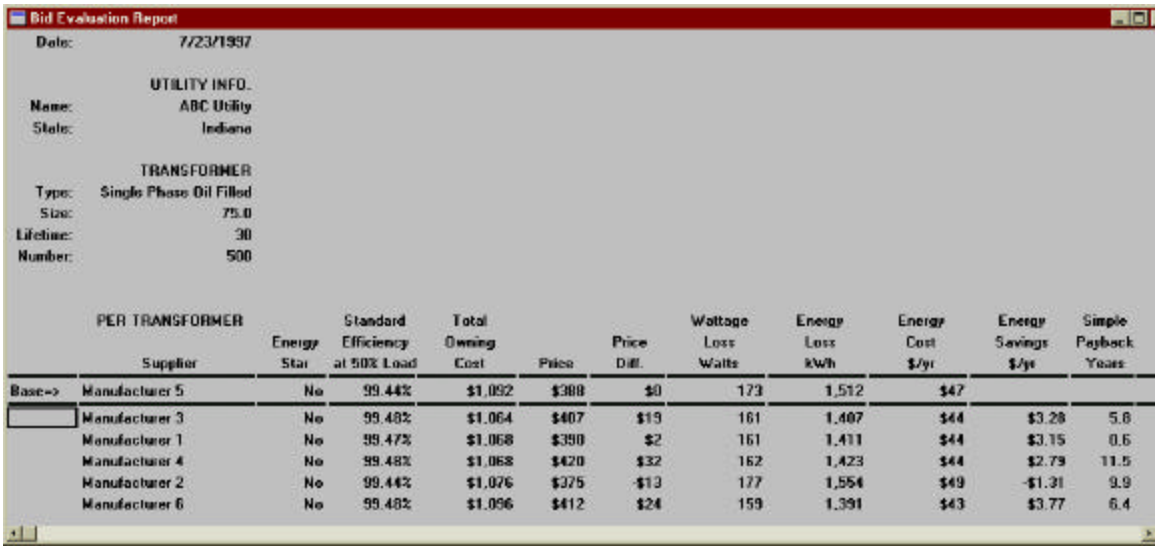


Figure 64: Report Control Panel

Enter the number of units you wish to purchase and the method by which you want to sort the transformer bids. The select the transformer bids you wish to analyze and the transformer bid which you would like to use as the "basecase". The "basecase" transformer should be the transformer you would have purchased prior to running DTCEM. When you have finished entering this information, click on the "Run the Report" button to run the report.

The "Bid Evaluation Report" pops up as shown in Figure 65.



	PER TRANSFORMER Supplier	Energy Star	Standard Efficiency at 50% Load	Total Owning Cost	Price	Price Diff.	Wattage Loss Watts	Energy Loss kWh	Energy Cost $/yr	Energy Savings $/yr	Simple Payback Years
Base=>	Manufacturer 5	No	99.44%	$1,092	$388	$0	173	1,512	$47		
	Manufacturer 3	No	99.48%	$1,064	$407	$19	161	1,407	$44	$3.28	5.8
	Manufacturer 1	No	99.47%	$1,068	$390	$2	161	1,411	$44	$3.15	0.6
	Manufacturer 4	No	99.48%	$1,068	$420	$32	162	1,423	$44	$2.79	11.5
	Manufacturer 2	No	99.44%	$1,076	$375	-$13	177	1,554	$49	-$1.31	9.9
	Manufacturer 6	No	99.48%	$1,096	$412	$24	159	1,391	$43	$3.77	6.4

Figure 65: Bid Evaluation Report

This report screen is not maximized when it is displayed. It may be necessary to use the scroll bars on the right side and the bottom of the screen to scroll through the entire report.

The top part of the report contains information about the utility and the transformers. The bottom part of the report contains two tables, both of which analyze the energy costs, benefits, and emissions avoided. These values in the top row of the table are for the "base case" transformer. The remaining rows display values for the other transformers relative to this base case.

➜ ***Double click in the upper left hand corner of the Bid Evaluation Report to close this screen.***

It should be noted here that the simple payback may be a negative number. Simple payback is calculated by dividing the price difference by the energy savings/year. The potential scenarios and details what the simple payback in each of these cases means is detailed in Appendix C.

Step 8. Save the Bid Evaluation

After following through Steps 1 through 7 you will have successfully entered the information necessary to analyze transformer bids for a utility. The next step is to save the file such that it can be opened and edited at a later date.

➜ ***Click on the save bid icon (Figure 66) on the toolbar.***

➜ ***Enter the name of the file in the "Select a Filename" box and click on the OK button.***

Figure 66: Save Bid icon

3.3 Other Optional Features

The previous sections describe how to enter the basic information needed to analyze transformer bids in DTCEM for utilities with unknown core and winding losses. This section details several of the options contained under the **Tools** menu which allow you to further edit the defaults associated with the program.

The DTCEM Tools menu consists of three options which allow you to edit some of the key parameters used in calculating the total owning cost (TOC) of a transformer. Specifically, these options allow you to enter information about the avoided costs of energy and generation capacity (Capacity Planner), the avoided cost of transmission and distribution capacity (Transmission/Distribution Planner), and the rate schedules and load schedules (RateVision). These options are described in detail below:

Capacity Planner (GC & EC)

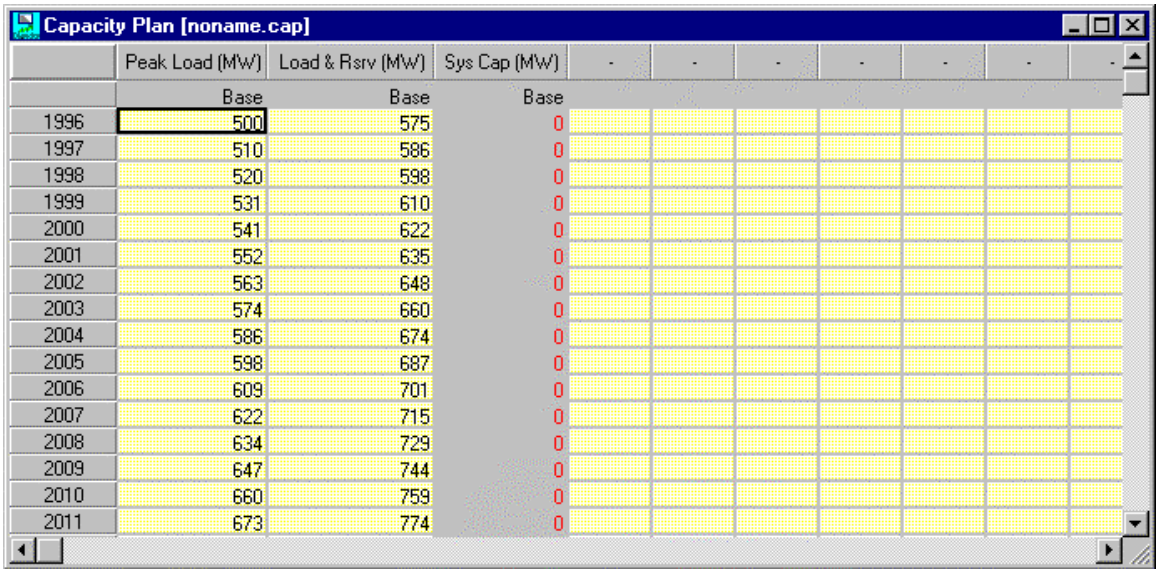
The capacity planner tool allows you to estimate the avoided costs of generation capacity (GC) and energy capacity (EC). The Capacity Planner develops base case and change case scenarios for providing capacity and energy. The base case represents the costs of providing a certain capacity. The change case is generated by decrementing (lowering) the capacity requirements by some amount (e.g., 10%) and re-estimating the cost of providing the necessary capacity. Because in most cases capacity expansion plans can be delayed by some number of years, the present value costs between the two cases represents the costs avoided by decrementing the system's capacity.

Figure 67: Capacity Planner icon

To generate a capacity expansion plan you need to select the period of analysis (e.g. 1996 - 2030), the system's peak load requirements (MW), and a means for achieving the capacity requirements (e.g., new power plants, purchasing power, DSM). You can enter up to 30 capacity source that can go "on-line" or "off-line" at any time you wish during the period of analysis. (If your selected capacity options do not meet your specified target requirement, DTCEM indicates this with a red typeface in the "Sys Cap (MW)" column of the worksheet.) Each capacity source has associated with it a capital cost and operating cost which can be modified as necessary. DTCEM will use these capital and operating costs to estimate the total capital and operating cost of this "base case" expansion plan scenario.

After defining this base case expansion plan, the next step is to "decrement" it by some amount (e.g., 10%) and then re-evaluate the requirements for meeting this lower capacity requirement. DTCEM will perform this evaluation automatically by determining the maximum amount of time that each capacity source can be "deferred." Deferring one or more of the capacity sources by one or more years will lead to a savings in the net present value of the capital costs and operating costs. Dividing the capital cost savings by the amount of capacity decremented results in an estimate of the avoided cost of capacity in $/MW. Similarly, dividing the operating cost savings by the amount of energy generation avoided results in an estimate of the avoided cost of energy in $/kWh.

To open a worksheet to calculate the avoided cost of generation capacity and the avoided cost of energy, click on the Capacity Planner icon (Figure 67) on the toolbar or choose **Generation & Energy (GC & EC)** from the **Tools** menu. The "Capacity Plan" table pops up as shown in Figure 68 below.



	Peak Load (MW)	Load & Rsrv (MW)	Sys Cap (MW)	-	-	-	-	-	-	-
	Base	Base	Base							
1996	500	575	0							
1997	510	586	0							
1998	520	598	0							
1999	531	610	0							
2000	541	622	0							
2001	552	635	0							
2002	563	648	0							
2003	574	660	0							
2004	586	674	0							
2005	598	687	0							
2006	609	701	0							
2007	622	715	0							
2008	634	729	0							
2009	647	744	0							
2010	660	759	0							
2011	673	774	0							

Figure 68: Capacity Planner Table

In addition, a floating Capacity Planner "Control Panel" is displayed on top of the table. This control panel contains several icons which allow you to enter and edit the information detailed in the Capacity Plan. In addition, this Control Panel shows the output created from the information entered. The icons and the output table are described at the end of this section on page 49.

A series of steps should be followed to ensure that all of the necessary information is added to this table. These steps are detailed below:

Set the Years of Analysis

The first thing you should do is set the years for which you are planning the capacity by clicking on any one of the years in the first column. The "Set the Years of Analysis" dialog box (Figure 69) pops up in which you should enter the start and end years for the period of analysis. Click on OK to save and continue.

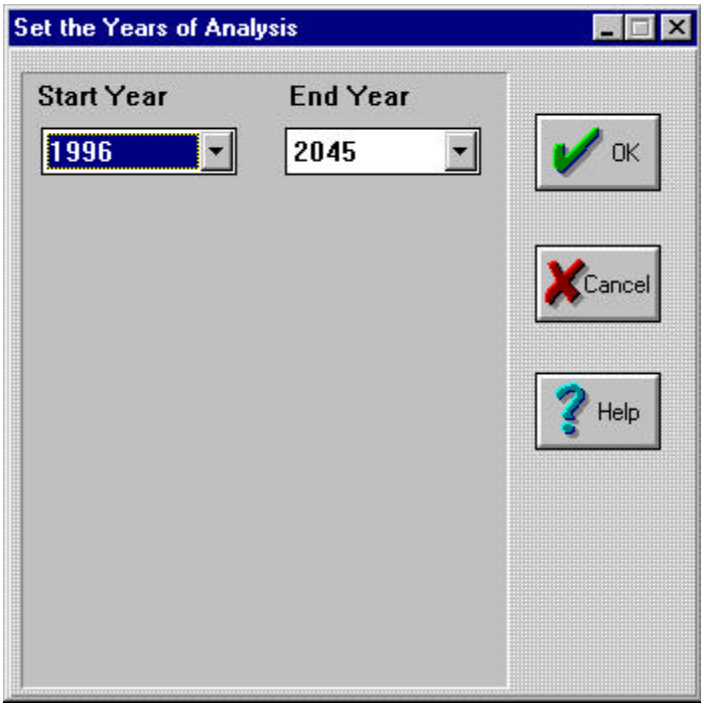


Figure 69: Set Years Dialog Box

Enter the Capacity Needed

The next step is to enter the capacity needed for the years of analysis. To open the **Enter the Capacity Needed Dialog Box** (Figure 70), double click in the **Peak Load** column.

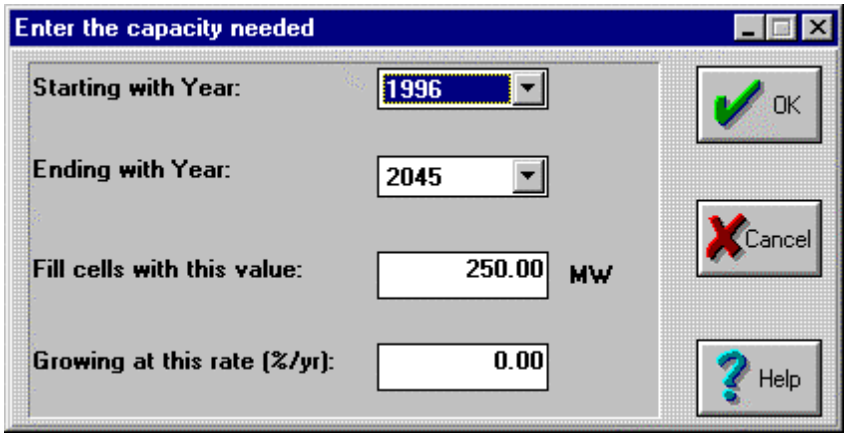


Figure 70: Enter the Capacity Needed Dialog Box

Use the picklists to enter a starting year and ending year, and enter the capacity in MW. For smaller units (< 1 MW) use decimals to enter the capacity (e.g., 200 kW is 0.2 MW). Enter the peak load growth rate, if applicable. Click OK to accept this information.

Set the Reserve Margin

The next step is to enter the load and reserve margin expected for this capacity. To open the "Set the Reserve Margin" dialog box (Figure

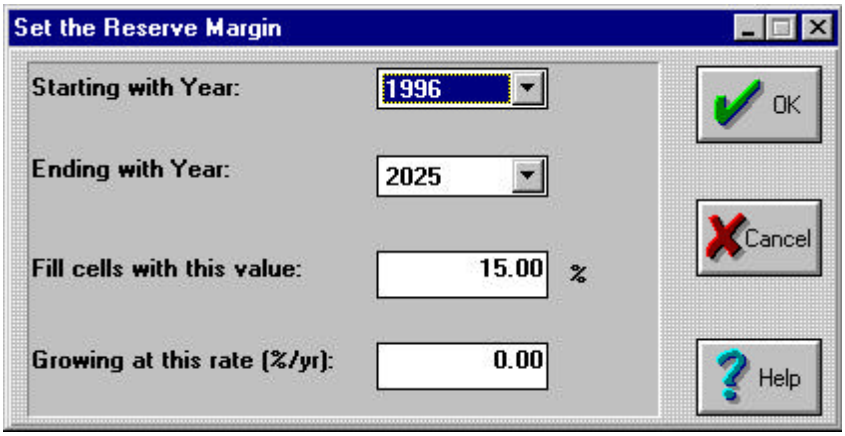


Figure 71: Set Reserve Margin Dialog Box

71), double click in the Load and Reserve column.

This dialog box allows you to select the reserve margin capacity needed for a given period of analysis. Use the picklists to enter a starting year and ending year. Enter the percent reserve margin in the box labeled "Fill Cells With This Value". The percent entered will be added to the capacity needed in the **Peak Load** column and displayed in the corresponding cells in the **Load and Reserve** column. Enter the peak load growth rate, if applicable. Click on OK to save and continue.

Create Capacity

The next step is to add the capacity to be supplied. To open the "Create Capacity" dialog box (Figure 72), double click on a cell in the fourth column or higher of the Capacity Planner window.

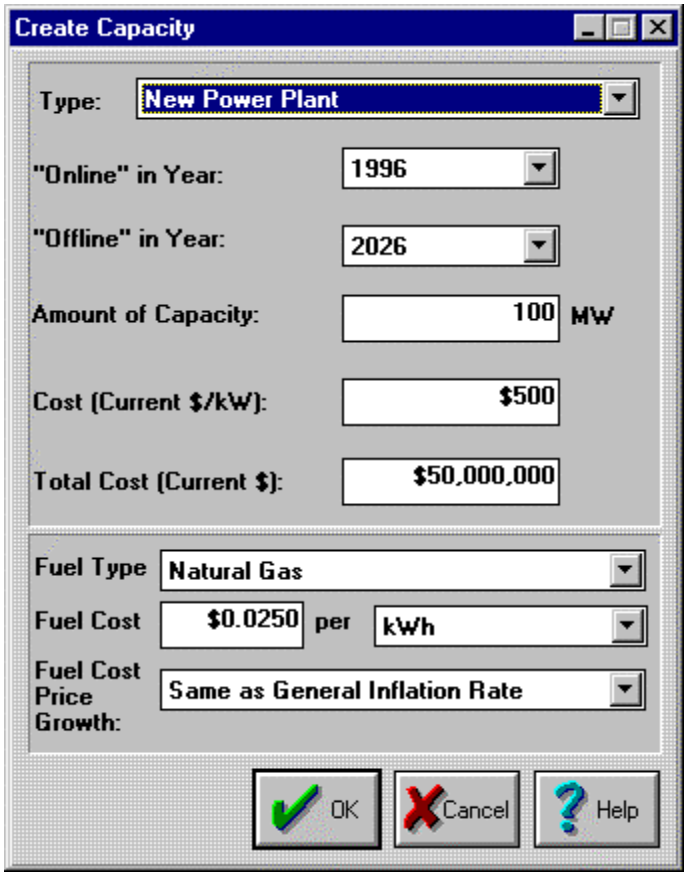


Figure 72: Create Capacity Dialog Box

In the top part of the screen, select or enter the following capacity information:

- Type of power or reduction in power (new power plant, power agreement purchase, etc.)
- Years the power (e.g., power plant) will be on-line
- Amount of effective capacity (MW)
- Cost per kW of this new capacity

In the bottom of the dialog box, select or enter the following fuel information:

- Fuel Type (natural gas, oil, etc.)
- Fuel Cost
- Fuel Cost Price Growth (at the defined general inflation rate)

Click on OK to save the changes. Created capacities are displayed in the rows corresponding to the appropriate years.

Continue to add capacity until the **System Capacity** column values are greater than or equal to the **Load and Reserve** column (*Note: System capacity values that are greater than or equal to the Load and Reserve values are displayed in the System Capacity column in black text. Values less than the Load and Reserve values are displayed in red text.*).

Set the Decrement

The next step is to enter the decrement value for the generation of the change case capacity plan. Click on the decrement icon (Figure 73) in the **Capacity Planner Control Panel** to open the "Enter the Amount in MW to Decrement Capacity By" dialog box (Figure 74).

Figure 73: Decrement icon

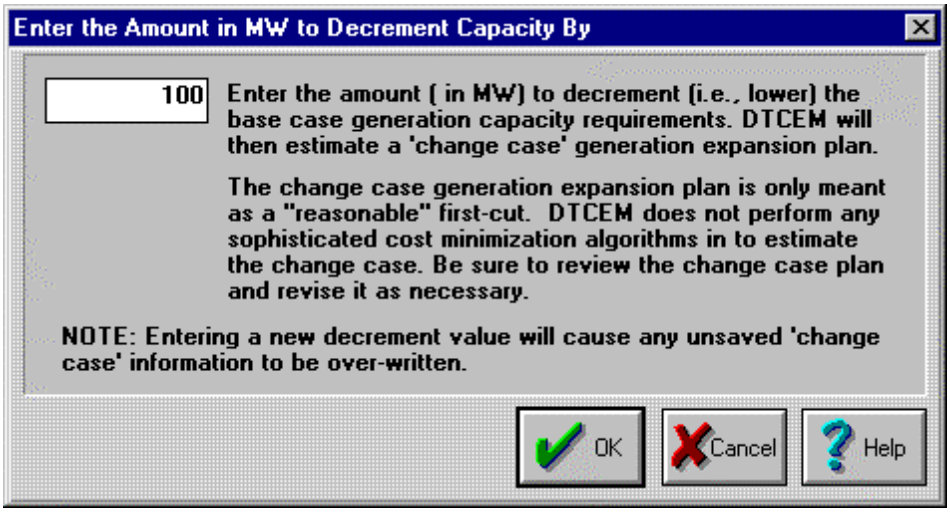


Figure 74: Decrement Dialog Box

You should enter the amount in MW to decrement (i.e., lower) the base case generation capacity requirements. DTCEM then calculates a 'change case' generation expansion plan.

Enter the decrement value in the white edit box. Click on OK to save and continue.

Save the Capacity Plan

The final step is to save the capacity plan as a *.cap file. This file may be used later in the Cost Factors table to calculate GC and EC. Click on the save icon (Figure 75) in the Capacity Planner Control Panel or click F6. Saved *.cap files may be retrieved in later sessions by clicking on the Open icon (Figure 76) in the Capacity Planner Control Panel or clicking F5.

Figure 75: Save icon

Figure 76: Open icon

Capacity Planner Control Panel

The Capacity Planner "Control Panel" (Figure 77) contains a table outlining the results of adding capacity to the Capacity Planner Table and a series of icons which may be used to access additional features of the Capacity Planner.

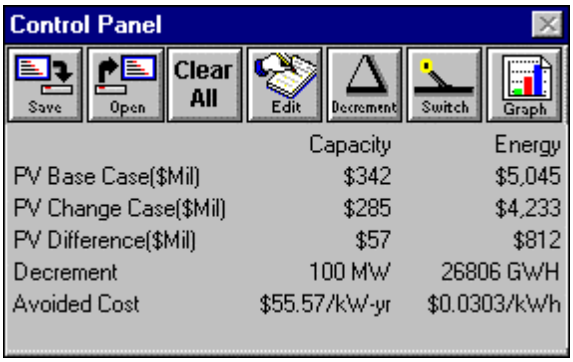


Figure 77: Capacity Planner Control Panel

This control panel is displayed over the top of the Capacity Planner table. You may move the control panel but you may not close it.

Capacity Planner Control Panel Table

The following values are contained within the Capacity Planner Control Panel table:

- Present value (PV) Base Case
- Present value (PV) Change
- Present value (PV) Difference
- Decrement
- Avoided Cost

These values are displayed for the capacity (how much is costs to purchase the capacity) and energy (how much it costs to operate the capacity).

Capacity Planner Control Panel Icons

A set of icons are presented at the top of the Capacity Planner Control Panel allowing you to operate some additional controls in the Capacity Planner. The save, open, and decrement icons have already been described in previous sections. The following additional features are accessible through these icons.

Save icon:	Save a capacity plan (*.cap file).	
Open icon:	Open a capacity plan (*.cap file).	
Clear All icon:	Clear all of the added capacities.	
Edit icon:	Edit one of the added capacities.	
Decrement icon:	Set the value for the generation of the change case capacity plan.	
Switch icon:	Switch between viewing the base and change case capacity plans (Be sure to set the decrement first or the base case and change case will be identical).	
Graph icon:	Graph the capacity required and the capacity achieved by the capacity plan throughout the years of analysis.	

Transmission/Distribution Planner

The purpose of the Transmission/Distribution Planner tool is to estimate the avoided cost of transmission and distribution capacity. Unlike the Capacity Planner tool (described above) which relies on projected future costs, the Transmission/Distribution Planner relies on historical information. The reason for the difference in approach is the difficulty in projecting future costs for transmission and distribution capacity. The historical data necessary for the approach used by the Transmission/Distribution Planner is generally available at most utilities. However, the applicability of these historical costs as the basis for estimating future incremental transmission and distribution capacity costs should be carefully considered.

The Transmission/Distribution Planner estimates the incremental costs of transmission and distribution using the slope coefficient from a linear regression (i.e. least-squares fit) of cumulative capacity investments on cumulative load growth. The relationship is:

$TD = **intercept** + **slope** * (System Capacity in MW)

The slope of this line can be interpreted as the marginal cost of providing an additional increment of transmission and distribution capacity. In estimating the regression lines the cumulative capacity investments should be suitably adjusted for inflation (e.g., expressed in 1996 dollars).

The Transmission/Distribution Planner allows you to enter capacity and investments over a period from 1970 to 1996. Values need only be entered where data are available. The Transmission/Distribution Planner adjusts the investment dollars for inflation. The inflation values used may be modified as necessary. After the data is entered, the regression can be run and the estimated relationship graphed. Details for using each of the Transmission/Distribution Planner tools are described below.

To start the Transmission/Distribution Planner, click on the Trans/Dist Planner icon (Figure 78) on the toolbar or choose **Transmission & Distribution (TD)** from the **Tools** menu. The "Transmission/Distribution Plan" table pops up as shown in Figure 79 below.

Figure 78: t Planner on

Transmission/Distribution Plan [noname.tdf]

	T&D Invest. (Actual $Mil)	Total System Load (MW)	Inflation (Pct/Yr)	T&D Invest. (Adjusted $Mil)	T&D Invest (Adjusted $Mil)
1980	0.0	0	0.0	0	0
1981	0.0	0	0.0	0	0
1982	0.0	0	0.0	0	0
1983	0.0	0	0.0	0	0
1984	0.0	0	0.0	0	0
1985	0.0	0	0.0	0	0
1986	0.0	0	0.0	0	0
1987	0.0	0	0.0	0	0
1988	0.0	0	0.0	0	0
1989	0.0	0	0.0	0	0
1990	0.0	0	0.0	0	0
1991	0.0	0	0.0	0	0
1992	0.0	0	0.0	0	0
1993	0.0	0	0.0	0	0

Figure 79: Transmission/Distribution Plan

In addition, a floating Transmission/Distribution Planner Control Panel is displayed on top of the table. This control panel contains several icons which allow you to enter and edit the information detailed in the Transmission/Distribution Plan. In addition, this Control Panel shows the output created from the information entered. The icons and the output table are described at the end of this section on page 52.

A series of steps should be followed to ensure that all of the necessary information is added to this table. These steps are detailed below:

Set the Years of Analysis

The years of analysis are currently set to 1970 to 1996 and cannot be changed. A subsequent version of DTCEM will allow you to modify the analysis years. Please note that you do not need to enter data for every year. You may enter data for the years you have data available.

Enter Transmission/Distribution Investment

The next step is to enter the transmission and distribution investment in actual dollars. These values are directly entered into the appropriate cream colored cells. Dollar values should be entered in millions of dollars (e.g., $10 million dollars should be entered as 10).

Enter Total System Load

The next step is to enter the total cumulative system load in MW. These values can be directly entered into the appropriate cream colored cell. DTCEM will not let you enter a cumulative system load that is less than the previous year's cumulative system load.

Enter Inflation Rate

The next step is to review the inflation rate in percent per year for the corresponding years of analysis. DTCEM provides you with default inflation rate values based on the U.S. Federal Reserve Board GDP deflator. These values can be edited as necessary.

Save the Transmission/Distribution Plan

The final step is to save the transmission/distribution plan as a *.tdf file. This file may be used later in the Cost Factors table to calculate TD. Click on the save icon (Figure 79) in the Trans/Dist Planner Control Panel or click F6. Saved *.tdf files may be retrieved in later sessions by clicking on the Open icon (Figure 81) in the Trans/Dist Planner Control Panel or clicking F5.

Figure 80: Save icon

Figure 81: Open icon

Transmission/Distribution Planner Control Panel

The Transmission/Distribution Planner "Control Panel" (Figure 82) contains a table outlining the results of adding transmission and distribution capacity to the Transmission/Distribution Planner Table and a series of icons which may be used to access additional features of the Transmission/Distribution Planner.

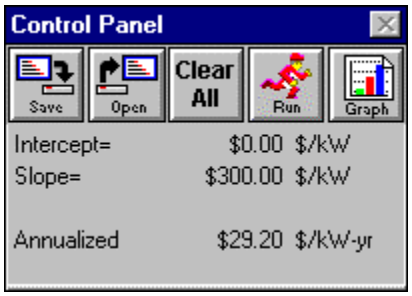


Figure 82: Transmission/Distribution Planner Control Panel

This control panel is displayed over the top of the Transmission/Distribution Planner table. You may move the control panel but you may not close it.

Transmission/Distribution Planner Control Panel Table

The following values are contained within the Transmission/Distribution Planner Control Panel table:

- Intercept
- Slope
- Annualized

The intercept is the no load transmission and distribution cost per kW. The slope is equal to the marginal, or incremental, cost of installing T&D capacity ($/kW). The annualized value is the annualized cost of transmission and distribution per kW.

Transmission/Distribution Planner Control Panel Icons

A set of icons are presented at the top of the Transmission/Distribution Planner Control Panel allowing you to operate some additional controls in the Transmission/Distribution Planner. These icons and their corresponding features are described below:

Save icon:	Save a trans/dist plan (*.tdf file).	
Open icon:	Open a trans/dist plan (*.tdf file).	
Clear All icon:	Clear all of the added transmission/distribution capacities.	
Run icon:	Run the regression analysis and see additional details for the regression analysis.	
Graph icon:	Graph the regression analysis. The graph displays the least-squares regression line along with the actual data points.	

RateVision

RateVision is a user friendly program designed to allow you to enter and analyze electricity rate schedules and energy use schedules. These schedules are saved in formats that are compatible with DTCEM and are used to determine the costs of core and winding losses.

Figure 83: Load profile builder icon

RateVision may be accessed by clicking on the RateVision button on the toolbar. By default, DTCEM looks for the RateVision program in your c:\ratevisi directory. You may change this directory if necessary by selecting **Setup | Set RateVision Directory**.

Load schedules may be used to calculate the load factor (LF) and peak responsibility factor (RF) when the calculation method is "Calc Losses (Generator)". A load schedule is a collection of daily load profiles that describes energy use over the course of a year. Individual load profiles list energy usage for each hour of the day. Energy usage typically varies by day of week and time of year.

RateVision load schedules (*.lsc) may be imported into the calculation worksheets for the LF and RF in the Load Characteristics screen. Both a system load schedule and a transformer load schedule may be imported if desired. These schedules are used to determine the load characteristics (hours per year, load factor, loss factor, coincidence factor, etc.) which are used in the calculation of the core and winding losses.

CHAPTER 4. ANALYZING TRANSFORMER COSTS FOR DISTRIBUTION COMPANIES AND COOPERATIVES

Distribution cooperatives without generation capability may need to calculate the A and B values needed by DTCEM to analyze the costs of the transformer bids. This requires that you enter **Load Characteristics** and **Cost Factors** information. DTCEM calculates these values using the following formulae:

$$A = \frac{(12 \times DC) + (HPY \times EC)}{FCR \times 1000}$$

$$B = \frac{\left(PL^2 \times RF^2 \times 12 \times DC\right) + \left(PL^2 \times HPY \times LsF \times EC\right)}{FCR \times 1000}$$

where:

DC	=	**Demand charge + Transmission/Distribution Charge**
EC	=	**Energy charge**
HPY	=	**Hours per year** (hours per year transformer is energized)
FCR	=	**Fixed charge rate** (cost of carrying capital on an investment)
RF	=	**Peak responsibility factor** (measure of the diversity of the load on the transformer)
LsF	=	**Transformer Loss Factor** (measure of the annual average load losses to the peak value of load losses on the distribution transformer.)
PL2	=	**Equivalent Annual Peak Load** (levelized annual peak load seen by the transformer)

The total cost of the transformer for each supplier is then calculated using the following formula:

Total Owning Cost = (Bid Price + Cost of Core Losses + Cost of Winding Losses)

where:

Cost of Core Losses = (1.0 + Loss Multiplier) * A value * Core Losses

Cost of Winding Losses = (1.0 + Loss Multiplier) * B value * Winding Losses

DTCEM has two methods for distribution companies to use to calculate the core and winding losses used to analyze transformer bids. The first option is to enter the information directly. This information includes the demand charge, energy charge, hours per year, responsibility factor, transformer loss factor, and equivalent annual peak load. This option is called "Calc Losses (Disco)". The second option is to import previously entered RateVision rate schedules and load schedules. These files contain the electricity and transformer load information in greater detail. This option is called "Model Losses (Disco)".

This chapter is organized into four sections as described below:

Section 4.1 Presents a case study and details the steps required for using the DTCEM Interview to analyze transformer bids using the "Calc Losses (Disco)" method.

Section 4.2 Details the steps needed to manually enter the information for the "Calc Losses (Disco)" option.

Section 4.3 Details the steps needed to manually enter the information for the "Model Losses (Disco)" option.

Section 4.4 Describes other optional features that may be used to further edit the defaults associated with the DTCEM program.

4.1 Entering Information Into the DTCEM Interview

This section presents a case study for an distribution company with unknown core and winding losses. The steps of the DTCEM Interview are introduced to show how to enter the case study information into the software program and identify the most cost-effective bid.

Case study

Chicago Co-op is a distribution cooperative providing power to the greater Chicago area. Chicago Co-op is looking to purchase 1,000 three phase oil filled transformers rated at 150 kVA, 120/240 voltage. Use the DTCEM Interview to calculate Chicago Co-op's core and winding losses (A and B factors).

Assume that Chicago Co-op received the following transformer bids:

Manufacturer	Bid	No-load (Core) loss	Load (Winding) loss
Manufacturer 1	$350	112 watts	460 watts
Manufacturer 2	$400	92 watts	375 watts
Manufacturer 3	$410	105 watts	360 watts
Manufacturer 4	$387	193 watts	410 watts
Manufacturer 5	$364	109 watts	395 watts

Start this case study by installing and running DTCEM as explained in the Installation Instructions on page 1. This case study describes entering the data through the DTCEM Interview. Upon starting the DTCEM Program you may start the interview by clicking "**Yes**" in the Welcome box. You may also start the interview by selecting **Interview** from the **Interview** menu.

The first interview screen pops up as shown in Figure 84 below:

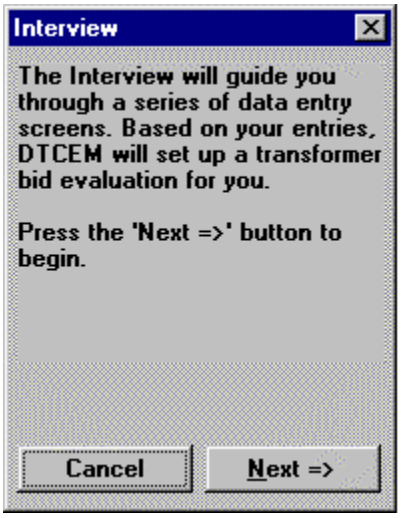


Figure 84: Interview Explanation screen

➜ ***To continue with the interview, click on the Next button.***

Step 1. Enter Utility Information

The first step is to enter the information about Chicago Co-op.

➜ ***Enter "Chicago Co-op" in the utility name box and select "Illinois" from the state pick list.***

For now, accept the default values for the emissions factors listed in the lower portion of the box (you may change these values by clicking in the appropriate white boxes, deleting the current values, and typing the correct values). The finished "Utility Information" screen should look like Figure 85 below:

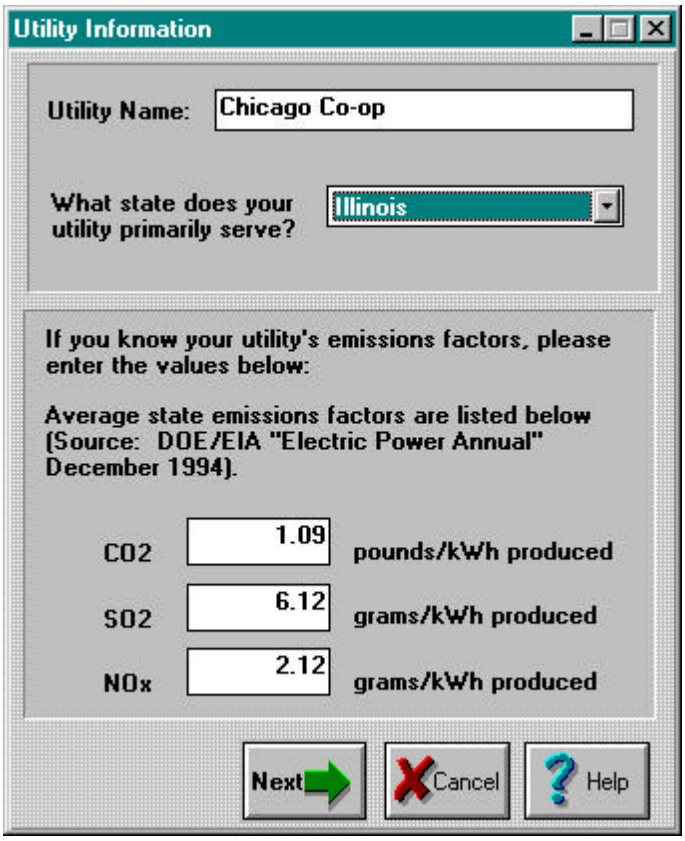


Figure 85: Chicago Co-op Information

➜ ***When you are finished, click on the Next button to continue with the Interview.***

Step 2. Enter Financial Factors

The next step is to enter the financial factors which will be used in the cost and benefit calculations. For this case study we will accept the default values given in this screen for all of the financial factors. The "Enter Financial Factors" screen looks like Figure 86 below:

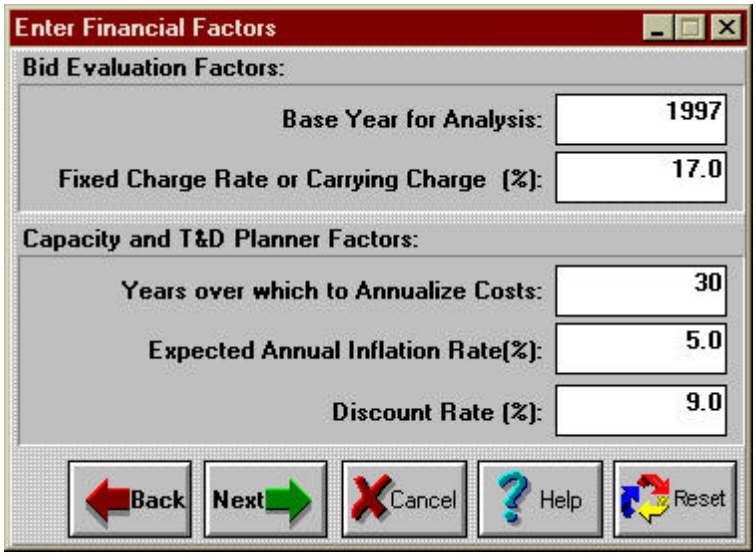


Figure 86: Financial Factors screen

This screen contains the base year for analysis, the years over which to annualize costs, the expected annual inflation rate (page 107), the discount rate (page 106), and the fixed charge rate (page 107). The annualization years, annual inflation rate, and the discount rate are used in the Capacity Planner to calculate the avoided cost of energy. The fixed charge rate is used to calculate the core and winding losses.

➜ ***Accept the defaults for these financial factors by clicking on the Next button.***

Step 3. Select a Calculation Method

The next step is to select the calculation method for estimating core and winding losses (A and B factors). You have the following three choices in this "Select the Calculation Method" screen (Figure 87):

1. Enter Losses Directly
2. Calc Losses (Generator)
3. Calc Losses (Disco)
4. Model Losses (Disco)

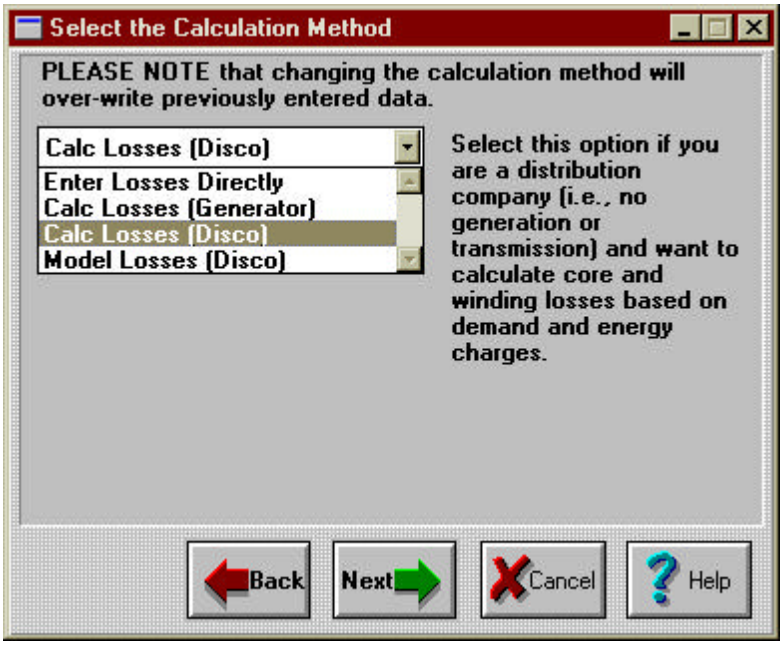


Figure 87: Calculation Method dialog box

➜ ***Chicago Co-op is a distribution cooperative and needs to calculate the core and winding losses. Chicago Co-op does not have previously defined rate and load schedules detailing the electricity and load characteristics. For these reasons, select "Calc Losses (Disco)" from the drop down list.***

➜ ***Click on the Next button to continue with the interview.***

Step 4. Enter Transformer Type and Size

The next step is to enter the size and type of transformers which Chicago Co-op wishes to purchase.

➜ ***Select Three Phase Oil Filled from the "Transformer Type" picklist.***

➜ ***Select 150 kVA from the "Transformer Size" picklist.***

➜ ***Select 30 in the "Transformer Lifetime" picklist.***

The completed "Select Transformer Type and Size" screen should look like Figure 88 below:

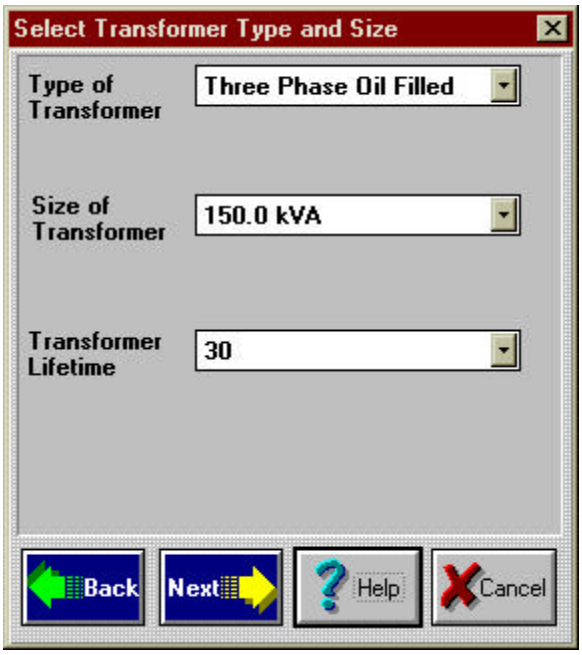


Figure 88: Chicago Co-op Transformer Type and Size Dialog Box

➜ ***Click on the Next button to continue with the interview.***

Step 5. Enter Load Characteristics

The next step is to enter the load characteristics, specific to the transformer's operating load. The transformer's operating load characteristics are used to estimate the amount of energy that will be lost by the transformer over its lifetime. The "Load Characteristics" screen is shown in Figure 89.

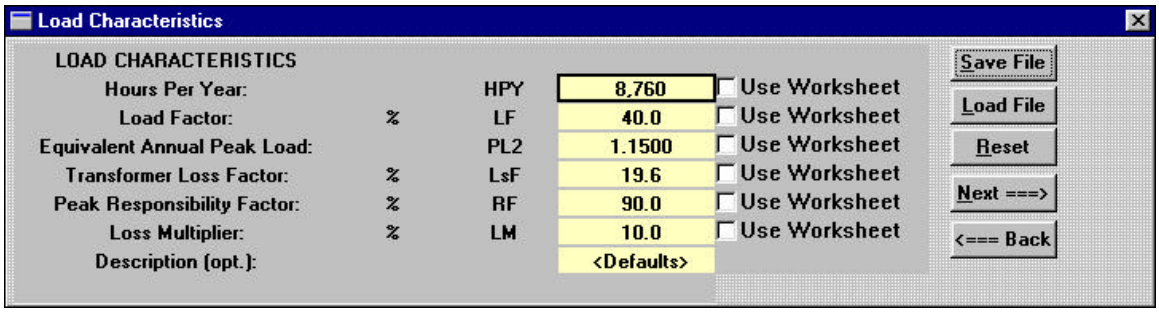


Figure 89: Load Characteristics screen

This screen includes default values for the load characteristics including:

- Hours Per Year (page 107)
- Load Factor (page 107)
- Equivalent Annual Peak Load (page 107)
- Transformer Loss Factor (page 109)
- Peak Responsibility Factor (page 108)
- Loss Multiplier (page 107)

These factors are used in the calculation of the load and no-load losses (except for the load factor which is only used for reporting purposes only). The values may be entered in this screen in one of two ways. First, the values may be directly entered by clicking in the corresponding cream colored cell and typing the correct value. Alternatively, the values may be calculated by clicking on the

corresponding "Use Worksheet" box to the right of the value and entering the information needed to calculate the value in the calculation sheet at the bottom of the screen.

For Chicago Co-op we will use the worksheet to calculate the value for the Transformer Loss Factor (LsF) and accept the defaults for the remaining factors.

➜ ***Click in the "Use Worksheets" box next to the "Transformer Loss Factor" cell.***

The Load Characteristics screen expands to show a calculation sheet with six tabs in the lower portion of the screen as shown in Figure 90. Only tabs corresponding to clicked "Use Worksheets" boxes in the upper portion of the screen are active. In this case, only the

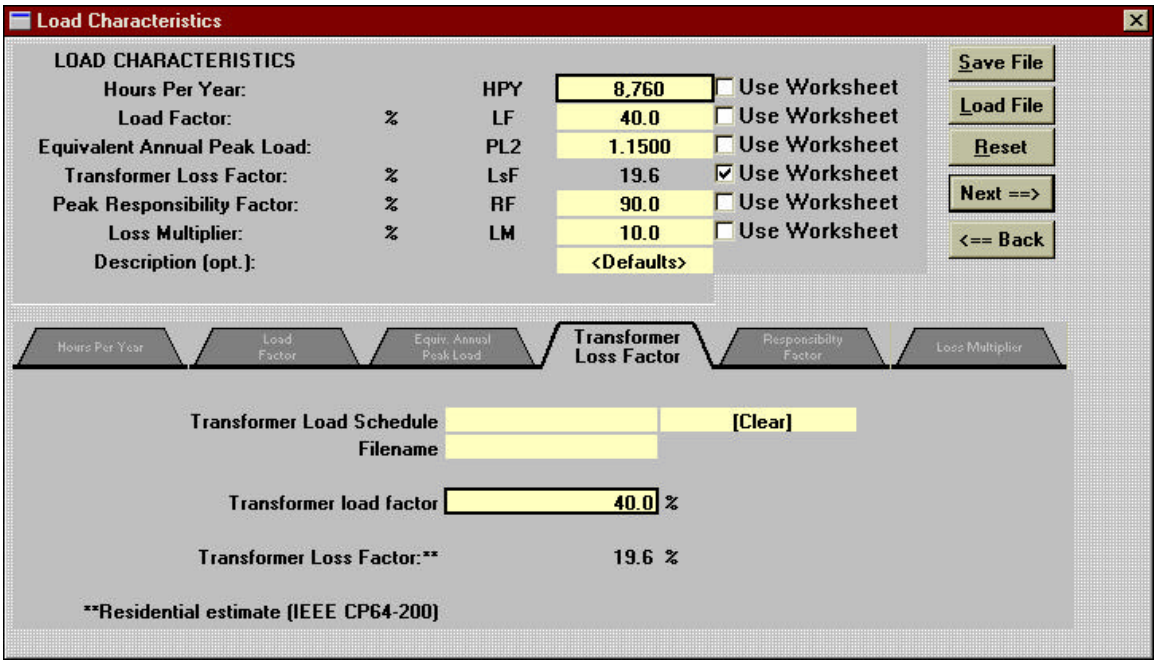


Figure 90: Transformer Loss Factor Calculation Sheet in the Load Characteristics screen

In this worksheet as well as the others, cream colored cells may be edited if necessary. To change a value, simply click into the desired cell and type the more accurate number. Some calculation sheets allow you to enter information stored in files (e.g., load schedules) by double clicking on cream colored cells.

In this case study, Chicago Co-op has already entered a transformer schedule called "tranload.lsc". This load schedule will be imported into DTCEM and used to recalculate the transformer loss factor.

➜ ***Double click in the cream colored box next to the "Transformer Load Schedule" text.***

➜ ***Select "tranload.lsc" from the pick list.***

The Transformer Loss Factor value changes to 58.3 from a default value of 19.6 after making this change. This change is reflected in both the top and bottom portion of the Load Characteristics screen as shown in Figure 91.

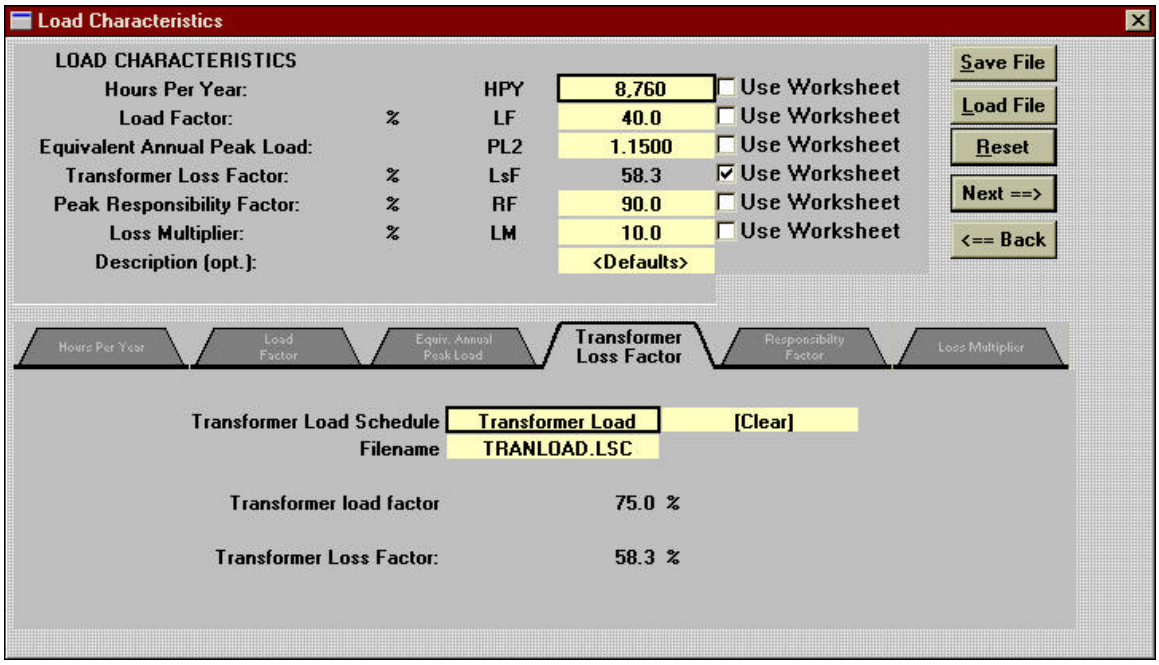


Figure 91: Changed Load Characteristics screen for Chicago Co-op

➜ ***Continue with the interview by clicking on the "Next" button.***

Step 6. Enter Cost Factors

The next step is to enter energy charges over the transformer lifetime. The Cost Factors dialog (Figure 92) shows these monthly energy charges including:

- Demand Charge (page 106)
- Energy Charge (page 107)
- Transmission and Distribution Charge (page 109)

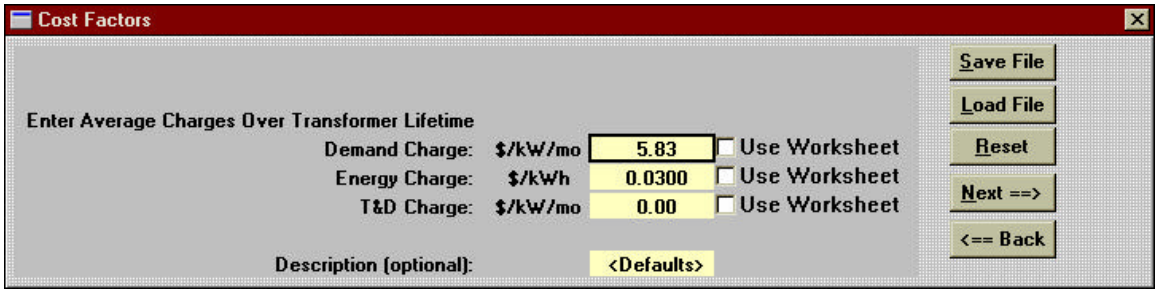


Figure 92: Cost Factors screen

These costs are used in the calculation of the value of the core and winding losses. The charges may be entered in this screen in one of two ways. First, the charges may be directly entered by clicking in the corresponding cream colored cell and typing the correct values. Alternatively, the charges may be calculated by clicking on the corresponding "Use Worksheet" box to the right of the value and entering the information needed to calculate the avoided cost in the calculation sheet at the bottom of the screen. By default, the Cost Factors screen calculates the values with the calculation sheets.

For Chicago Co-op we will edit the value for the demand charge (DC).

➜ ***Click on the Demand Charge tab in the lower portion of the screen.***

➜ ***Enter "4.00" in the Base Year Demand Charge cell.***

Note that the levelized demand charge over the transformer lifetime changes from $5.83/kW/mo to $6.37/kW/mo. The completed Cost Factors screen is shown in Figure 94 below.

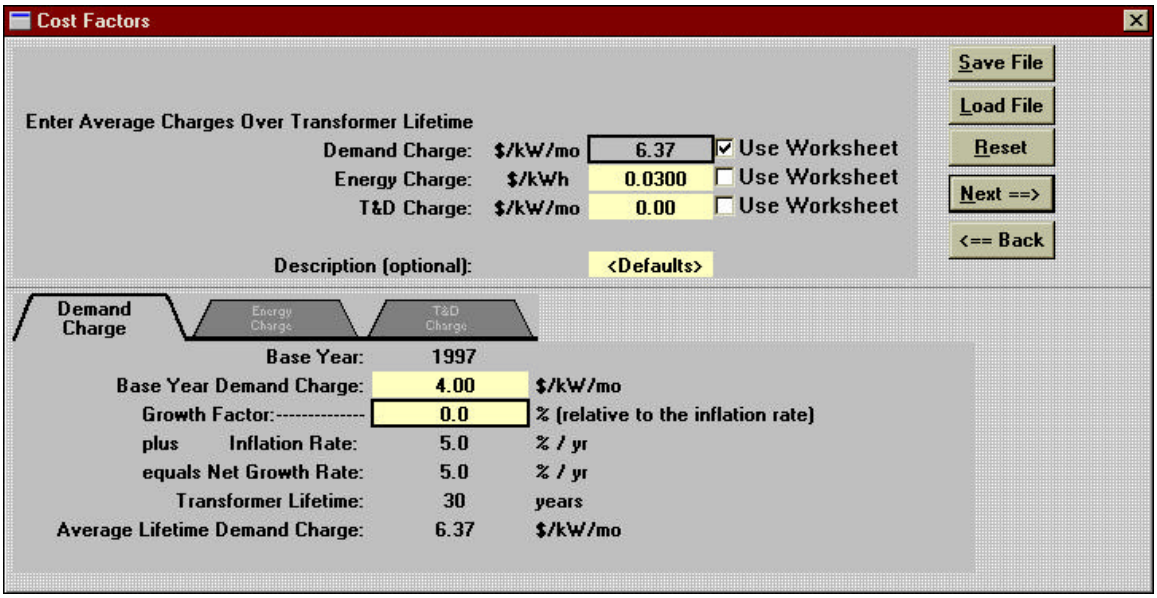


Figure 94: Cost Factors Screen

➜ ***Continue with this interview by clicking on the "Next" button.***

Step 7. Enter Transformer Bids

The next step is to enter the bids for the transformer made by the different suppliers. You should select **Yes** in the screen as shown in Figure 95 below:

Figure 95: A Question About Bids screen

You should then select **Yes** in the screen as shown in Figure 96 below:

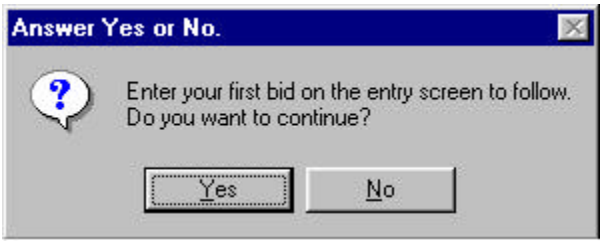


Figure 96: Answer Yes or No Screen

You will now see the "Enter a Transformer Bid" dialog box. In this screen you should enter the supplier's name, bid price, core losses, and winding losses.

➜ ***Enter "Manufacturer 1" in the Supplier Box.***

➜ ***Enter "350" in the Price Box.***

➜ ***Enter "112" in the Core Losses Box.***

➜ ***Enter "460" in the Winding Losses Box.***

The finished Transformer Dialog box should look like Figure 97.

Figure 97: Transformer Bid Dialog Box for Manufacturer 1

➜ ***Click on the OK button to continue with the interview.***

You should continue to answer **Yes** in the "Answer Yes or No" box (Figure 98) until you enter all 5 of the bids described at the top of this case study. Continue to enter the supplier's name, price, core losses, and winding losses as described above.

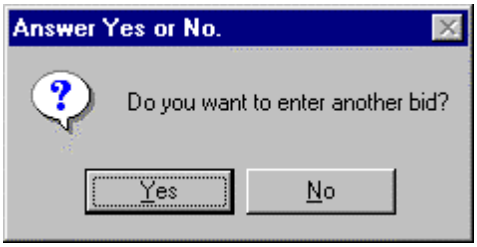


Figure 98: Answer Yes or No box

➜ ***When you have finished entering all five of the bids, click No in the "Answer Yes or No" Box.***

You have now completed the data entry portion of the case study. You should see an "All Done" box (Figure 99) indicating that you are finished.

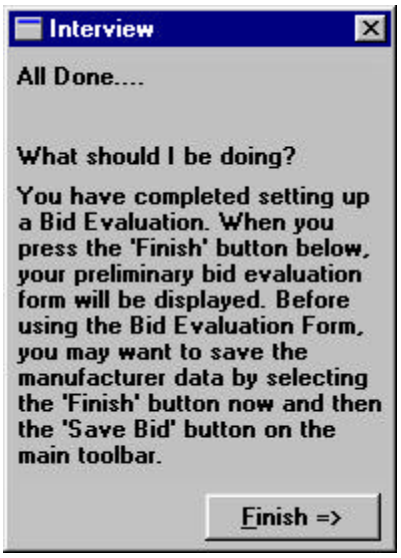
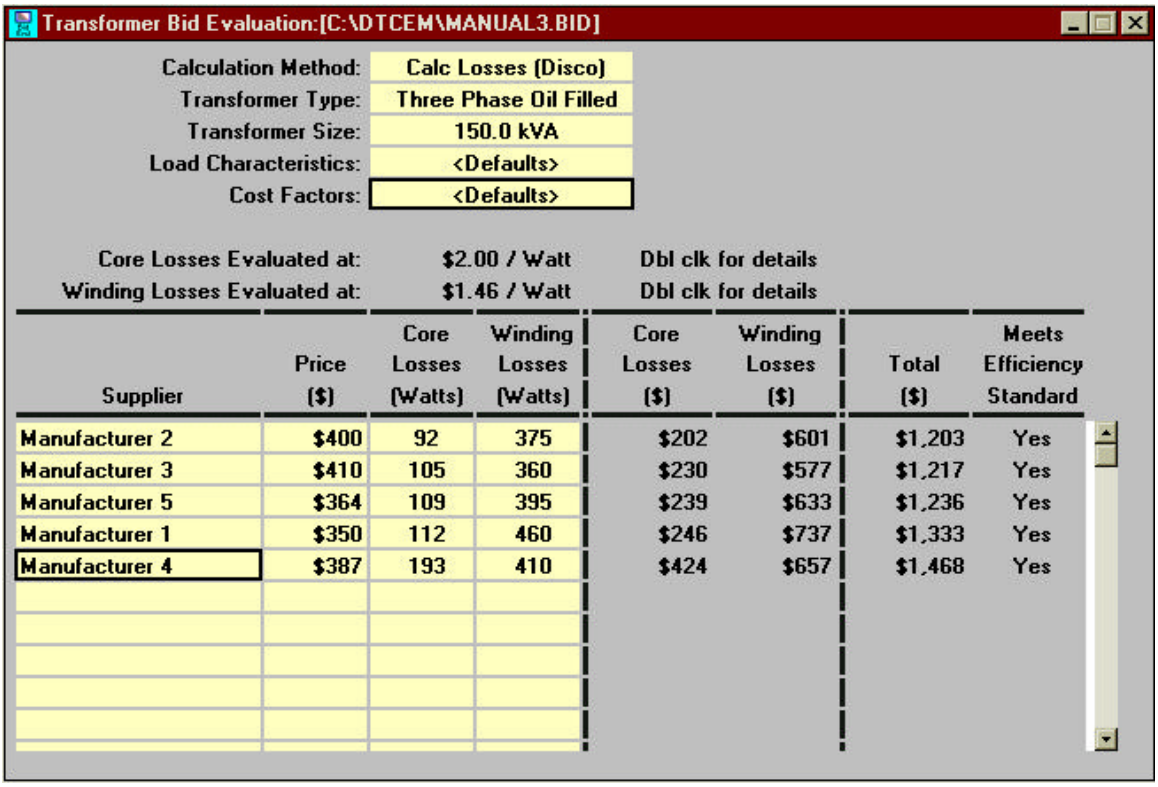


Figure 99: All Done Dialog box

➜ ***Click "Finish" to end the Interview.***

Your completed "Transformer Bid Evaluation Screen" pops up as shown in Figure 100 below.



Supplier	Price ($)	Core Losses (Watts)	Winding Losses (Watts)	Core Losses ($)	Winding Losses ($)	Total ($)	Meets Efficiency Standard
Manufacturer 2	$400	92	375	$202	$601	$1,203	Yes
Manufacturer 3	$410	105	360	$230	$577	$1,217	Yes
Manufacturer 5	$364	109	395	$239	$633	$1,236	Yes
Manufacturer 1	$350	112	460	$246	$737	$1,333	Yes
Manufacturer 4	$387	193	410	$424	$657	$1,468	Yes

Figure 100: Completed Bid Evaluation Screen for Chicago Co-op

As you can see, the bids are ordered from the lowest total cost to the highest. Manufacturer 2 has the lowest total cost despite having the second highest bid price. The total cost is calculated by using the following formula:

Total Owning Cost = Bid Price + Cost of Core Losses + Cost of Winding Losses

Step 8. Analyze the Data

The next step is to view the comparative energy costs and benefits for the different bids in the Bid Evaluation screen.

➜ ***Click on the Quick Report icon (Figure 102) on the floating toolbar.***

You are first shown the "Report Control Panel" in which you may select the number of transformers you wish to purchase, the method by which you want to sort the transformers, the transformer bids you wish to analyze, and the transformer bid which you wish to serve as the "base case".

Figure 102: Quick Report icon

➜ ***Enter "1000" in the Number of Units to Purchase box.***

➜ ***Click the "Lowest Total Owning Cost" option to sort the transformers.***

➜ ***Click the "Select All" button to select all of the bids to be analyzed.***

➜ ***Click on "Manufacturer 1" in the Bids Selected Box and then click on the "Select" button. (Assume that Chicago Co-op would have purchased transformers from Manufacturer 1 before analyzing the total owning costs in DTCEM. This report compares the costs and benefits of purchasing the transformers from the other manufacturers to the costs and benefits of purchasing Manufacturer 1's transformers.)***

Your finished "Report Control Panel" should look like Figure 103 below:

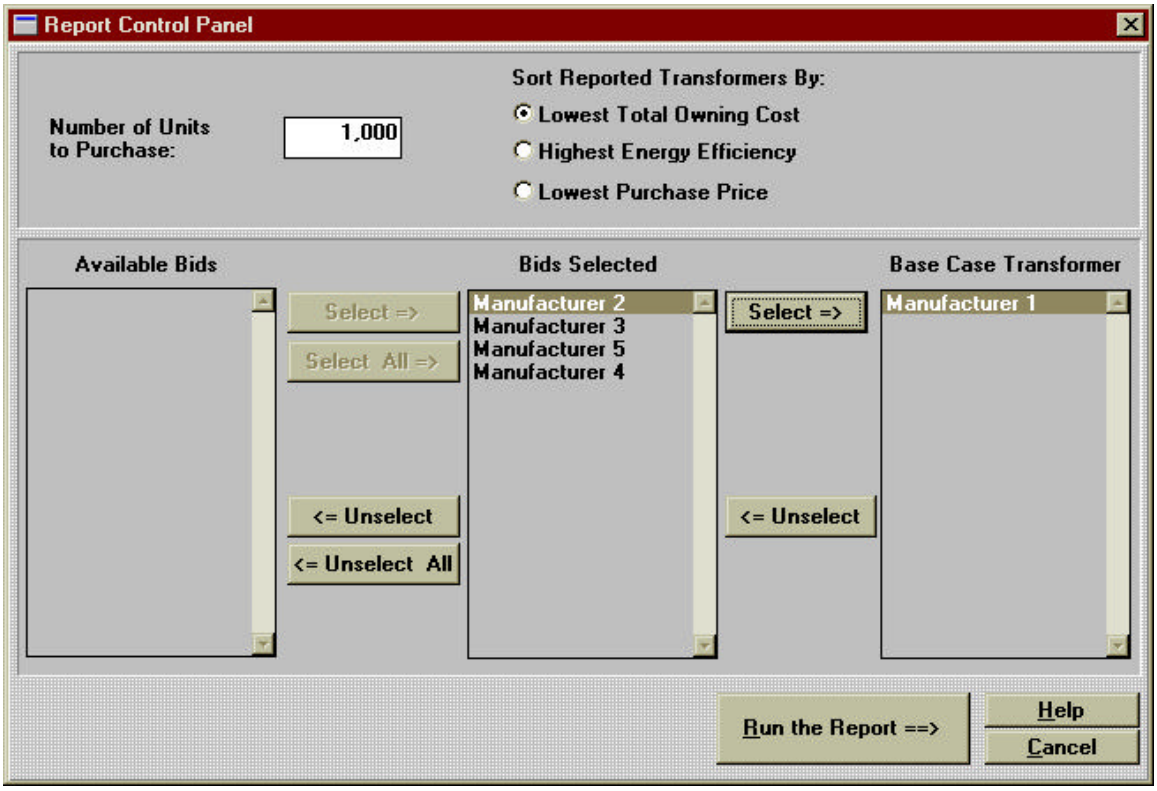


Figure 103: Report Control Panel for Chicago Co-op

➜ ***Click on the "Run the Report" button to run the report.***

The "Bid Evaluation Report" pops up as shown in Figure 104.

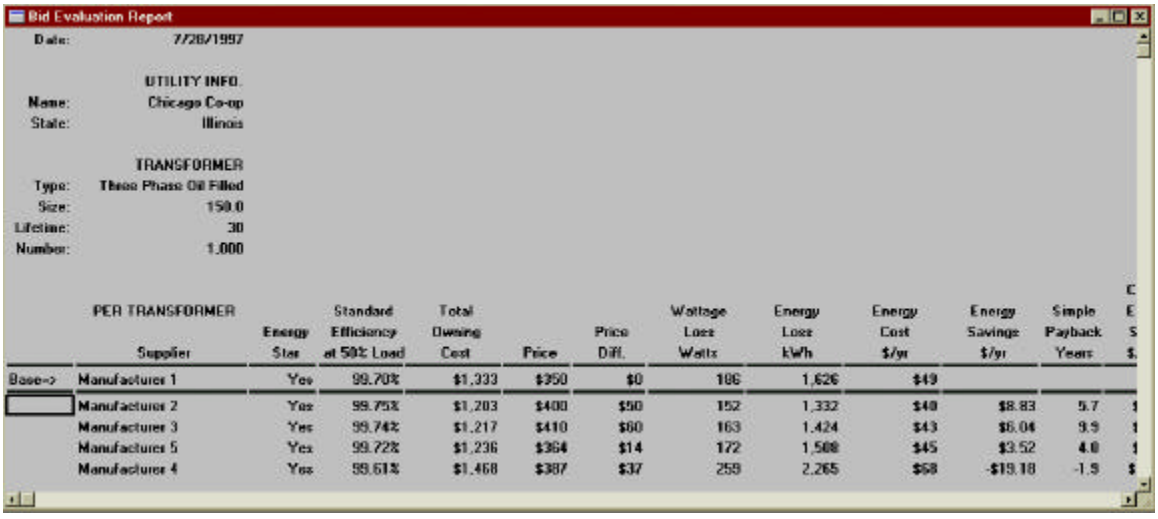


Figure 104: Chicago Co-op Bid Evaluation Report

This report screen is not maximized when it is displayed. It may be necessary to use the scroll bars on the right side and the bottom of the screen to scroll through the entire report.

The top part of the report contains information about the utility and the transformers. The bottom part of the report contains two tables, both of which analyze the energy costs, benefits, and emissions avoided. These values in the top row of the table are for the "base case" transformer from Manufacturer 6. The remaining rows display values for the other transformers relative to this base case.

If we compare the costs and benefits of Manufacturer 2's transformer to the basecase (Manufacturer 1) we see that despite costing $50 more per transformer ($50,000 more for 1,000 transformers) Manufacturer 2's transformer will save $8.83/year in energy ($8,830/year for 1,000 transformers) and will result in a 5.7 year payback period. Though the transformers from Manufacturer 2 will cost $50,000 more in initial capital costs, over the 30 year transformer lifetime, the transformers will save $264,900, ($8,830/year times 30 years) when compared to the transformers from Manufacturer 1.

It should be noted here that the simple payback may be a negative number. Simple payback is calculated by dividing the price difference by the energy savings/year. Appendix C outlines the potential scenarios and details what the simple payback in each of these cases means.

Step 9. Save the Bid Evaluation

Congratulations! You have successfully entered the information necessary to analyze transformer bids for a utility that has previously calculated A and B values. The next step is to save the file such that it can be opened and edited at a later date.

➜ ***Click on the save bid icon (Figure 104) on the toolbar.***

➜ ***Enter the name of the file in the "Select a Filename" box and click on the OK button.***

Figure 105: Save Bid icon

4.2 Entering Information Into DTCEM for the Calc Losses (Disco) Calculation Method

It may be appropriate at times to enter the information needed to analyze transformer bids with DTCEM manually, without the use of the Interview. This section details the steps needed to manually this information for distribution companies with unknown core and winding losses. This section specifically addresses the information needed to use the "Calc Losses (Disco)" calculation method.

Step 1. Start a New Bid Evaluation

The first step for manually entering information into the DTCEM Program for distribution companies with unknown core and winding losses is to start a new bid evaluation. Click on the new bid icon (Figure 106) on the toolbar.

Figure 106: New bid icon

A message box (Figure 107) pops up asking you whether you want to use the default bid evaluation template or select a different bid evaluation template. Bid evaluation templates are used to start new bid evaluations. Unless you have saved a separate bid evaluation template you should select Yes in this screen. More information about bid evaluation template files is covered on page 90.

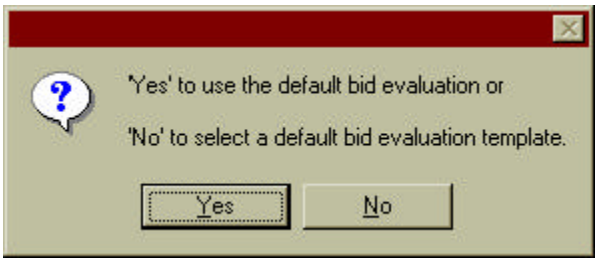


Figure 107: New Bid message box

A blank bid evaluation screen pops up as shown in Figure 108 below. *(Note that this screen may look different depending on the default template that is used to create this screen).*

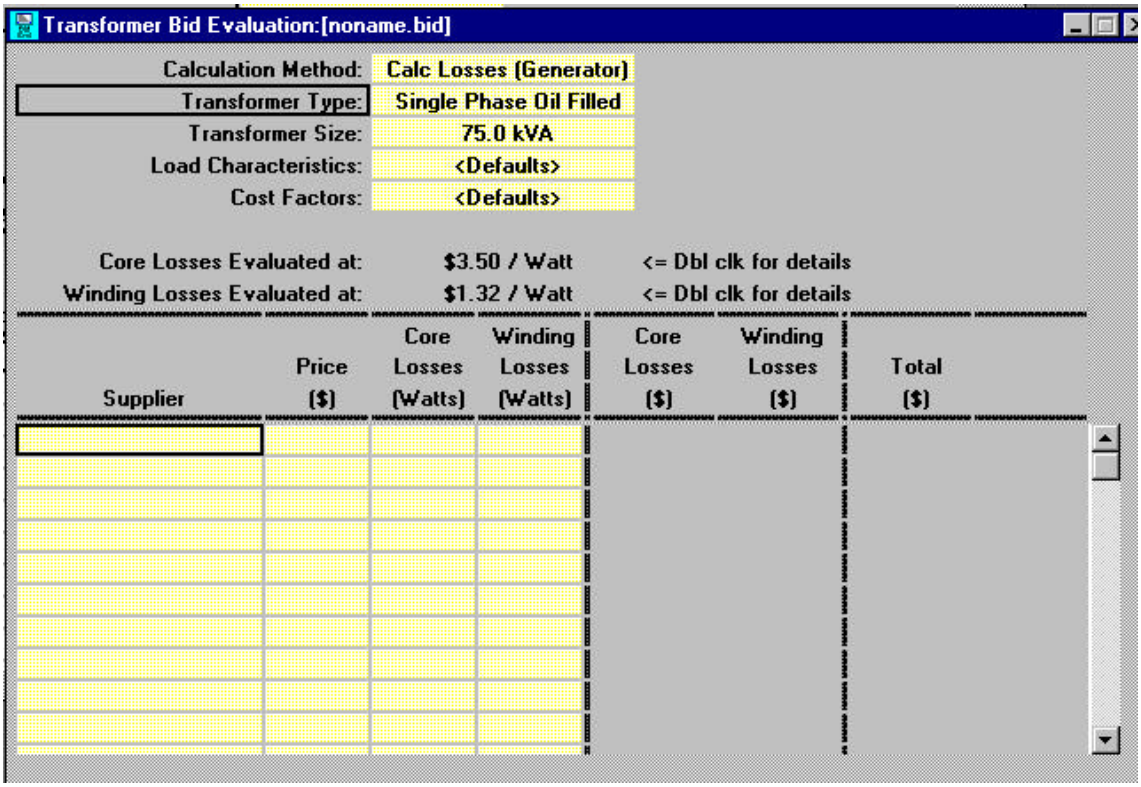


Figure 108: Blank Bid Evaluation Screen

Step 2. Select the Calculation Method

The next step is to select the calculation method that will be used to calculate the core and winding losses. Double click in the cream colored cell next to the Calculation Method text at the top of the Bid Evaluation Screen.

The "Select the Calculation Method" dialog box is presented as shown in Figure 109 below:

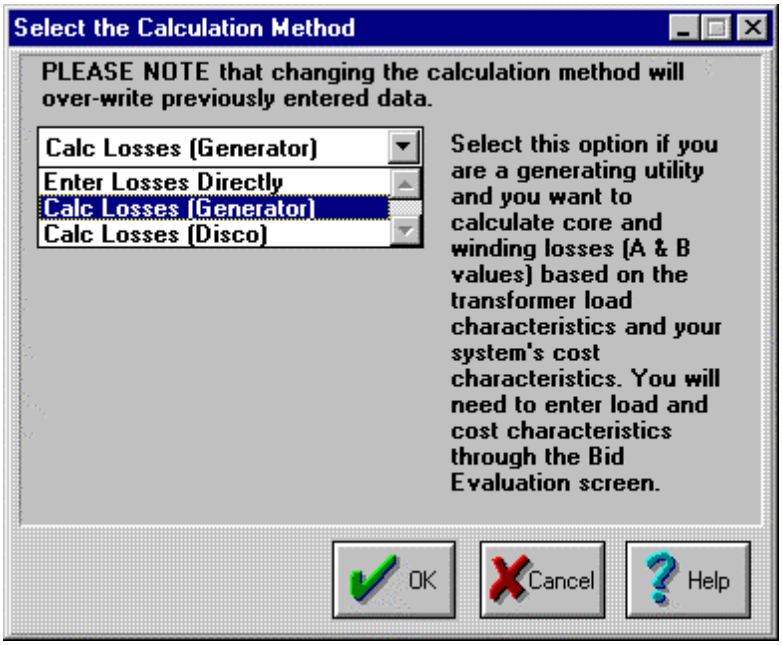


Figure 109: Select the Calculation Method dialog box

Distribution companies with unknown core and winding losses should select "Calc Losses (Disco)" from the drop down box. Click on OK to save and continue.

Step 3. Describe the Transformer Type and Size

The next step is to enter the size and type of the transformer desired. Double click on either the **Transformer Size** or **Transformer Type** cream colored box at the top of the Bid Evaluation table. The "Select Transformer Type and Size dialog box pops up as shown in Figure 110 below:

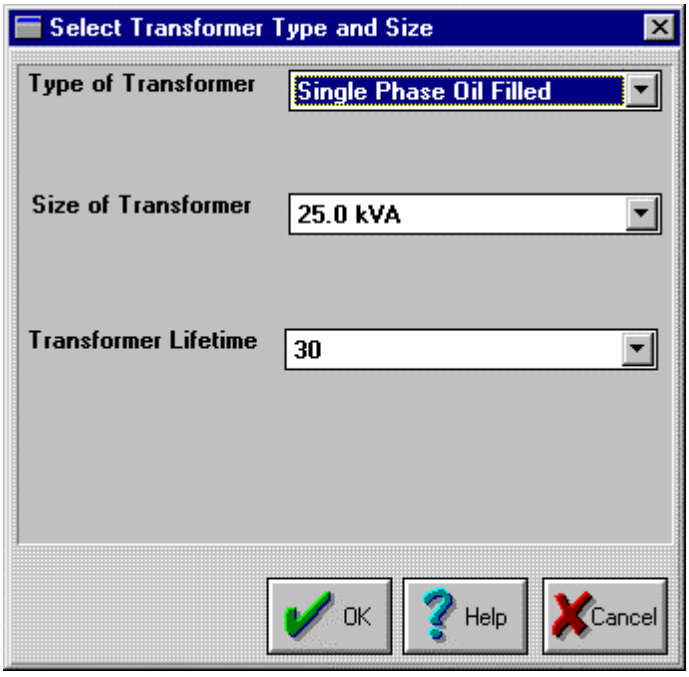


Figure 110: Select Transformer Type and Size dialog box

Three drop down lists are presented in this dialog. The top box shows the type of transformer, the middle box shows the size of the transformer in kVA, and the bottom box shows the transformer life in years. Any of the three parameters may be changed by clicking on the arrow to the right of the edit box. When you are finished, click on the OK button to exit. The changed size and type will be reflected in the Bid Evaluation screen.

Step 4. Edit the Load Characteristics

The fourth step is to edit the default load characteristics are created in DTCEM based on the calculation method and the type and size of the transformer. These characteristics may be edited by double clicking on the cream colored cell corresponding to the **Load Characteristics** at the top of the Bid Evaluation screen. The "Load Characteristics" box pops up as shown in Figure 111 below.

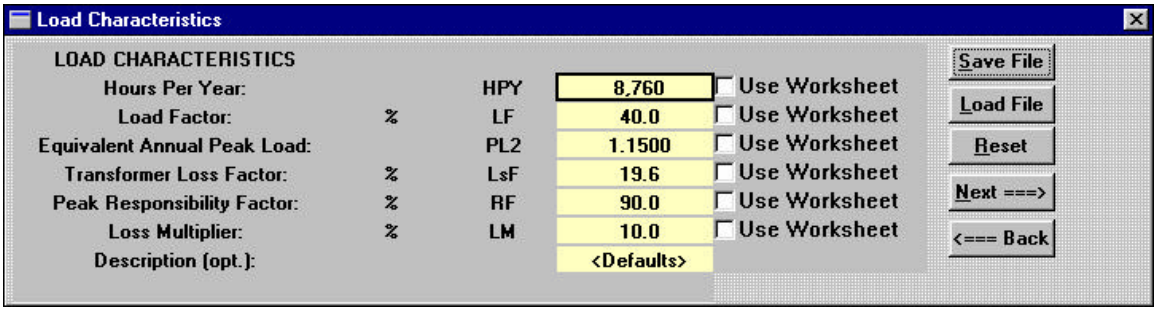


Figure 111: Load Characteristics Box

The load characteristics box contains the transformer's operating load characteristics. There are six different parameters in this screen:

- Hours Per Year (page 107)
- Load Factor (page 107)
- Equivalent Annual Peak Load (page 107)
- Transformer Loss Factor (page 109)
- Peak Responsibility Factor (page 108)

- Loss Multiplier (page 107)

In addition to these parameters, a description of the load characteristics may be entered in the Description box.

These factors may be entered directly in the cream colored box by clicking in the box and typing the correct value. The factors may also be calculated by using worksheets. To calculate a factor, click on the corresponding "Use Worksheets" box to the right of the cream colored box. A calculation sheet with six tabs is created in the lower portion of the screen as shown in Figure 112. Only tabs corresponding to clicked "Use Worksheets" boxes in the upper portion of the screen are active. While in a calculation sheet, any of the values in the cream colored boxes may be changed. Changed values are reflected in the upper portion of the "Load Characteristics" screen.

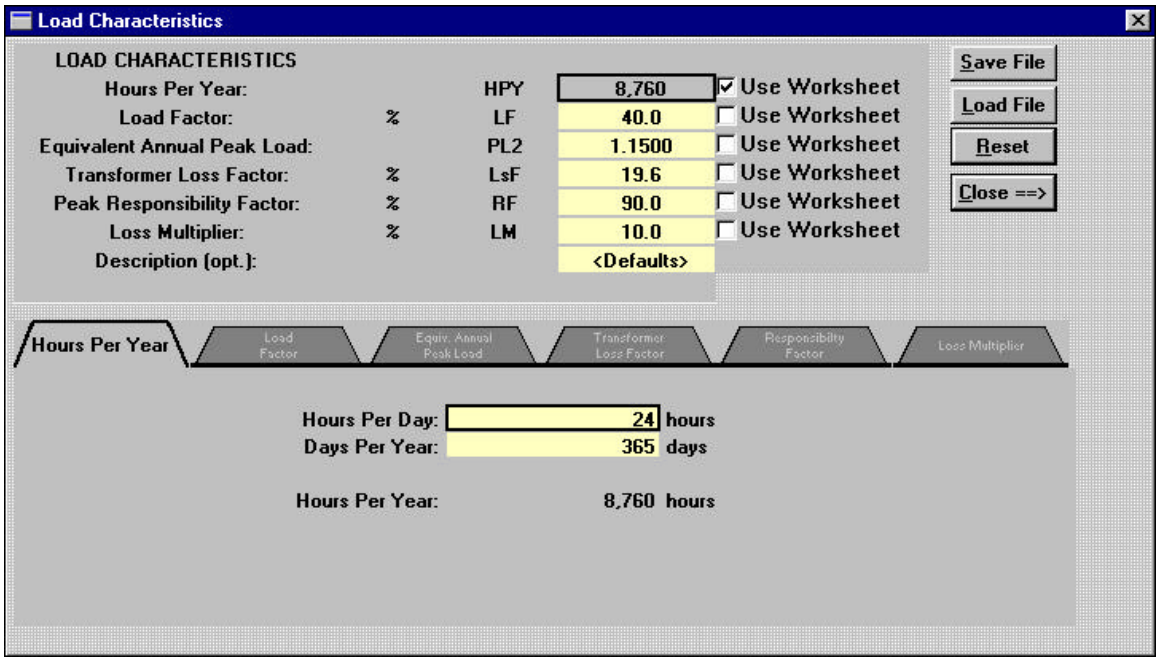


Figure 112: Expanded Load Characteristics screen

This screen may be closed by clicking on the Close button.

Step 5. Edit the Cost Factors

The next step is to enter the demand, energy, and transmission/distribution charges which are used to calculate the A and B values.. These charges may be edited by double clicking on the cream colored cell corresponding to the **Cost Factors** at the top of the Bid Evaluation screen. The "Cost Factors" box pops up as shown in Figure 113 below.

The following charges may be edited in this screen:

- Demand Charge (page 106)
- Energy Charge (page 107)
- Transmission and Distribution Charge (page 109)

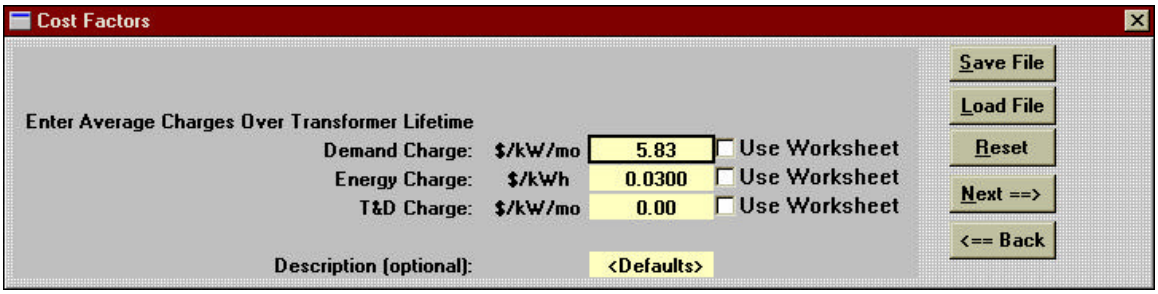


Figure 113: Cost Factors screen

These costs are used in the calculation of the value of the core and winding losses. The charges may be entered in this screen in one of two ways. First, the charges may be directly entered by clicking in the corresponding cream colored cell and typing the correct values. Alternatively, the charges may be calculated by clicking on the corresponding "Use Worksheet" box to the right of the value and entering the information needed to calculate the avoided cost in the calculation sheet at the bottom of the screen (Figure 115).

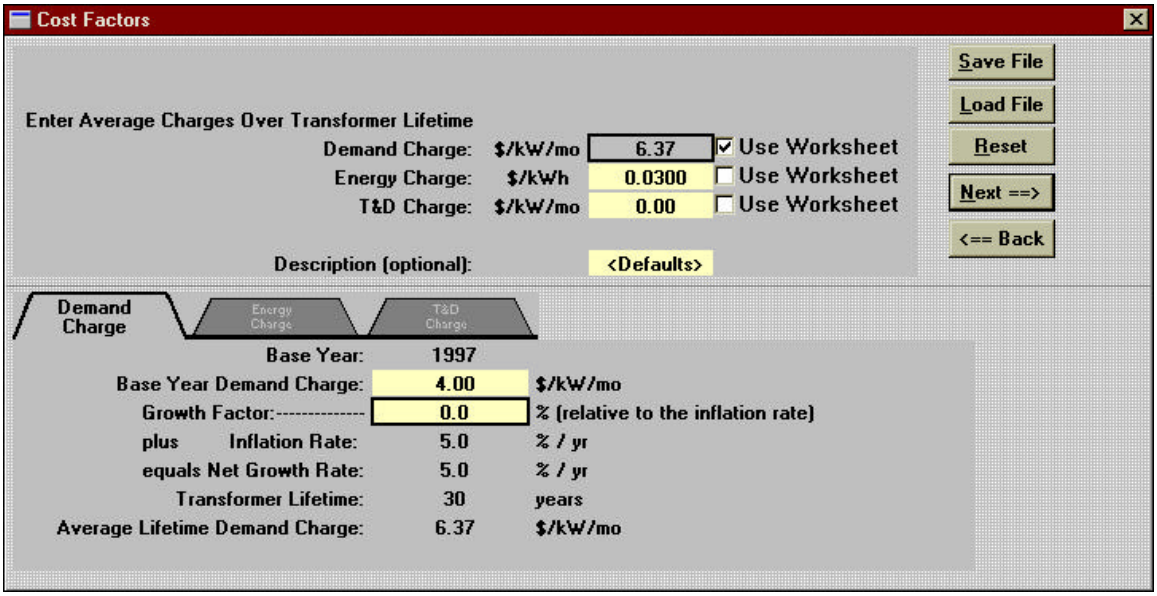


Figure 115: Cost Factors Screen

This screen may be closed by clicking on the Close button.

Step 6. Enter the Transformer Bids

The last required step in the manual data entry process for utilities with unknown core and winding losses is to enter the transformer supplier and price information in the bottom portion of the Bid Evaluation screen. This information may be entered by double clicking in a cream colored cell in one of the rows at the bottom of the Bid Evaluation screen. The "Enter a Transformer Bid" dialog box pops up as shown in Figure 116 below:

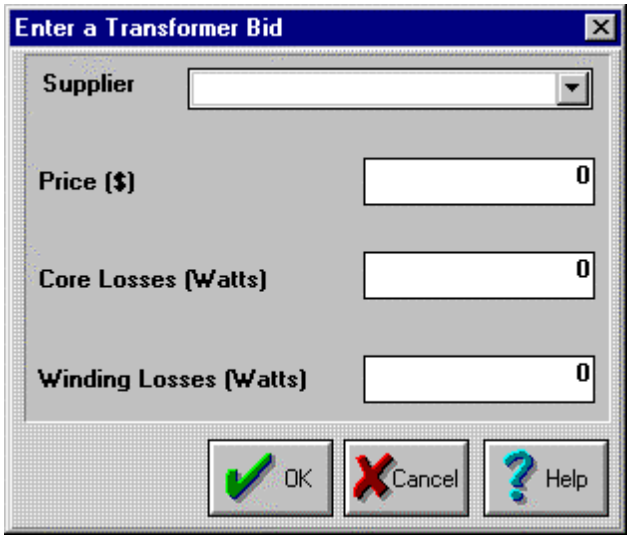


Figure 116: Enter a Transformer Bid dialog box

The information entered in this dialog is displayed in a row in the Bid Evaluation screen. The loss figures are multiplied by their appropriate incremental cost values to estimate the load loss and no-load loss costs. These values are then used to calculate the first year losses and the lifetime losses. As the bids are added to the Bid Evaluation screen, they are ranked and listed based on the lowest total owning cost (TOC).

Step 7. Analyze the Data

The next step is to view the comparative energy costs and benefits for the different bids in the Bid Evaluation screen.

➜ ***Click on the Quick Report icon (Figure 117) on the floating toolbar.***

You are first shown the "Report Control Panel" (Figure 118) in which you may select the number of transformers you wish to purchase, the method by which you want to sort the transformers, the transformer bids you wish to analyze, and the transformer bid which you wish to serve as the "base case".

Figure 117: Quick Report icon

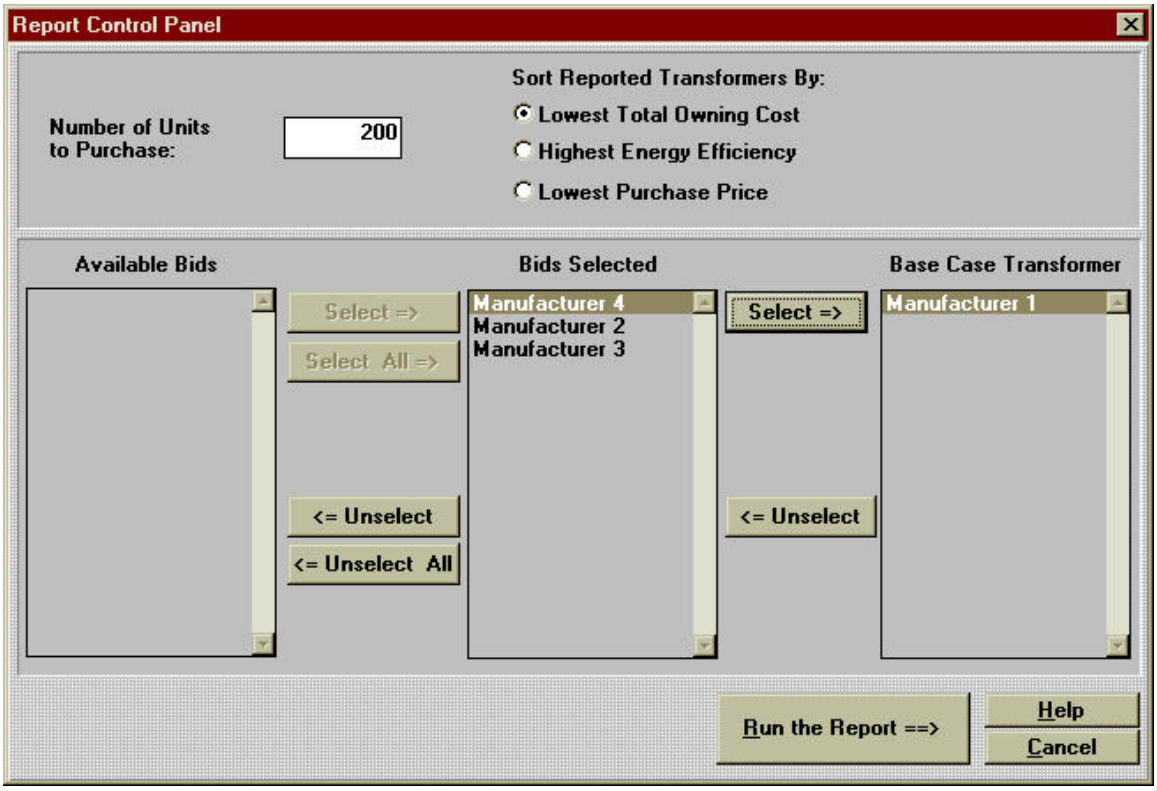


Figure 118: Report Control Panel

Enter the number of units you wish to purchase and the method by which you want to sort the transformer bids. The select the transformer bids you wish to analyze and the transformer bid which you would like to use as the "basecase". The "basecase" transformer should be the transformer you would have purchased prior to running DTCEM. When you have finished entering this information, click on the "Run the Report" button to run the report.

The "Bid Evaluation Report" pops up as shown in Figure 119.

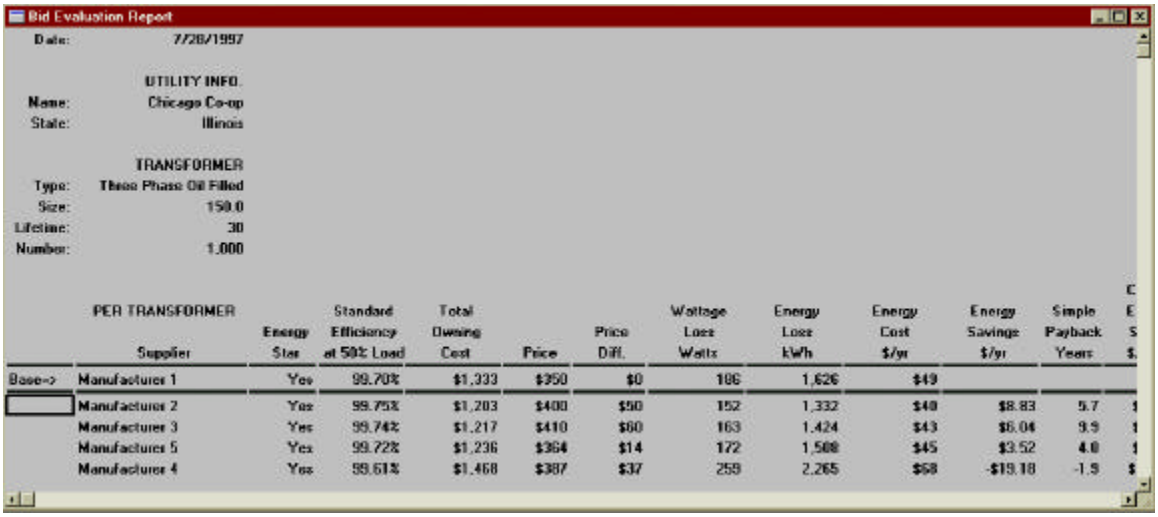


Figure 119: Bid Evaluation Report

This report screen is not maximized when it is displayed. It may be necessary to use the scroll bars on the right side and the bottom of the screen to scroll through the entire report.

The top part of the report contains information about the utility and the transformers. The bottom part of the report contains two tables, both of which analyze the energy costs, benefits, and emissions avoided. These values in the top row of the table are for the "base case" transformer. The remaining rows display values for the other transformers relative to this base case.

It should be noted here that the simple payback may be a negative number. Simple payback is calculated by dividing the price difference by the energy savings/year. The potential scenarios and details what the simple payback in each of these cases means is detailed in Appendix C.

Step 8. Save the Bid Evaluation

After following through Steps 1 through 7 you will have successfully entered the information necessary to analyze transformer bids for a distribution company. The next step is to save the file such that it can be opened and edited at a later date.

➜ ***Click on the save bid icon (Figure 120) on the toolbar.***

➜ ***Enter the name of the file in the "Select a Filename" box and click on the OK button.***

Figure 120: Save Bid icon

4.3 Entering Information Into DTCEM for the Model Losses (Disco) Calculation Method

Distribution companies may wish to analyze the energy efficiency and cost effectiveness of different transformer bids in greater detail than that offered with the Calc Losses (Disco) calculation method. The Model Losses (Disco) calculation method allows users to model complicated rate and load schedules to determine the cost and load factors needed to calculate the core and winding losses. This is particularly useful for cooperatives and companies that do not know the demand charge, energy charge, load factor, loss factor, and other values used to calculate the core and winding losses.

This section details the steps needed to manually enter this information for distribution companies with unknown core and winding losses.

Step 1. Start a New Bid Evaluation

The first step for manually entering information into the DTCEM Program for distribution companies with unknown core and winding losses is to start a new bid evaluation. Click on the new bid icon (Figure 121) on the toolbar.

Figure 121: New bid icon

A message box (Figure 122) pops up asking you whether you want to use the default bid evaluation template or select a different bid evaluation template. Bid evaluation templates are used to start new bid evaluations. Unless you have saved a separate bid evaluation template you should select Yes in this screen. More

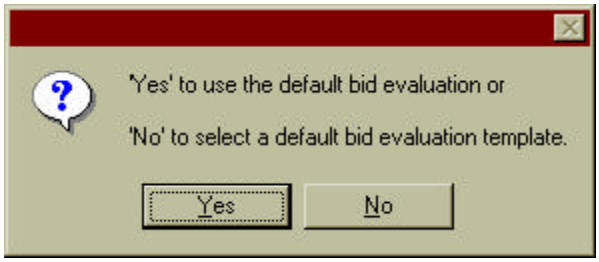


Figure 122: New Bid message box

information about bid evaluation template files is covered on page 90.

A blank bid evaluation screen pops up as shown in Figure 123 below. *(Note that this screen may look different depending on the default template that is used to create this screen).*

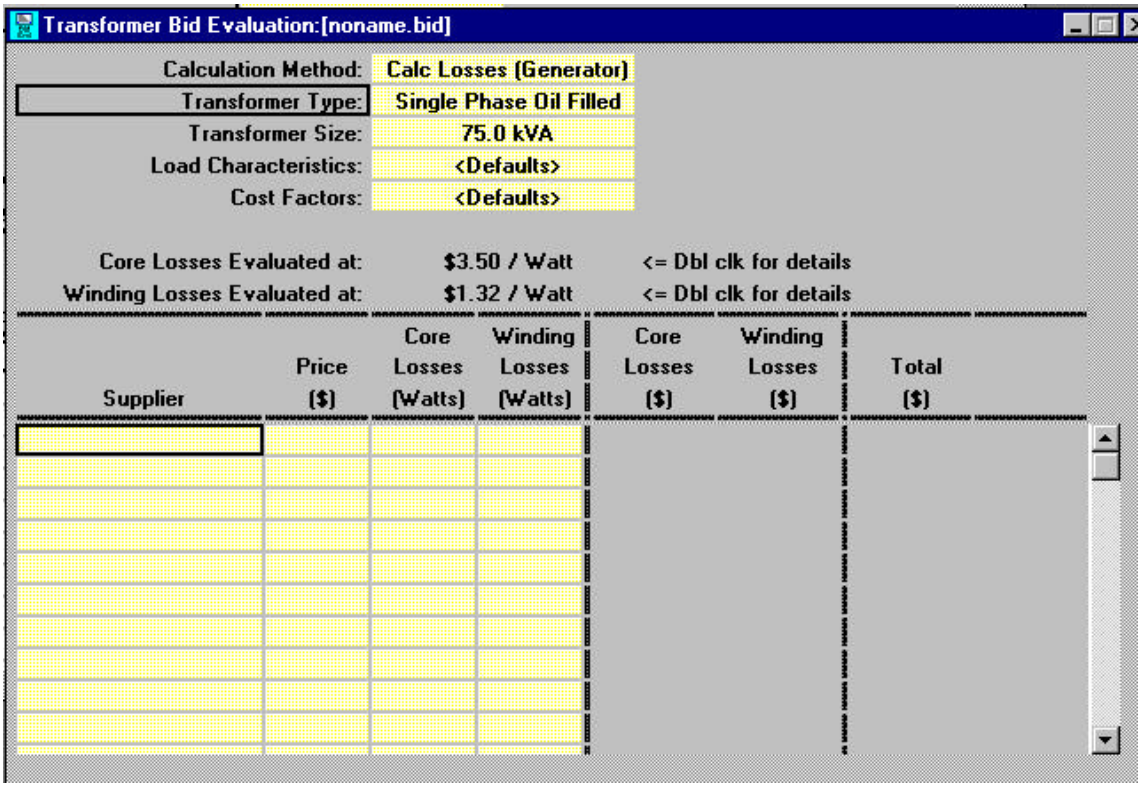


Figure 123

Step 2. Select the Calculation Method

The next step is to select the calculation method that will be used to calculate the core and winding losses. Double click in the cream colored cell next to the Calculation Method text at the top of the Bid Evaluation Screen.

The "Select the Calculation Method" dialog box is presented as shown in Figure 124below:

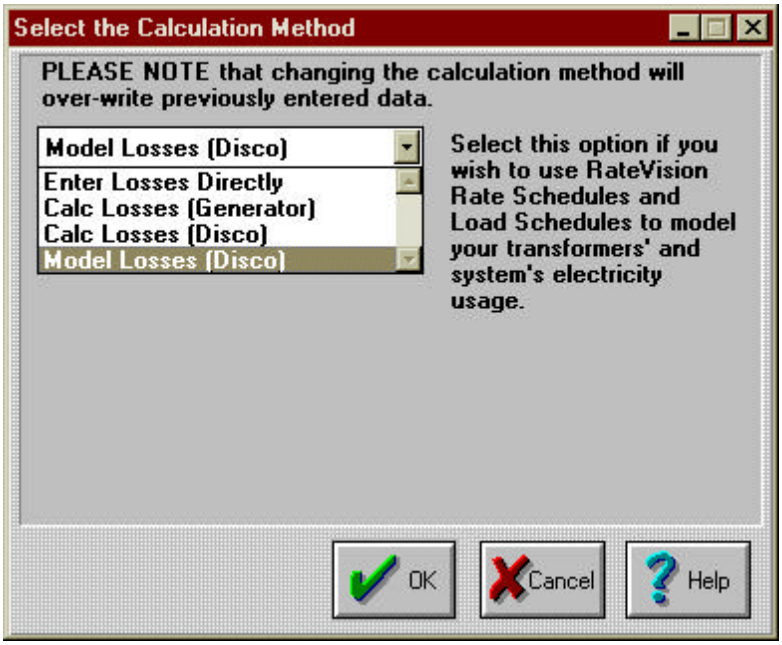


Figure 124: Select the Calculation Method dialog box

Distribution companies wishing to use RateVision rate schedules and load schedules to model their transformers' and systems' electricity

series of message boxes indicating this activity is occurring. This process may take several seconds.

Step 3. Describe the Transformer Type and Size

The next step is to enter the size and type of the transformer desired. Double click on either the **Transformer Size** or **Transformer Type** cream colored box at the top of the Bid Evaluation table. The "Select Transformer Type and Size dialog box pops up as shown in Figure 125 below:

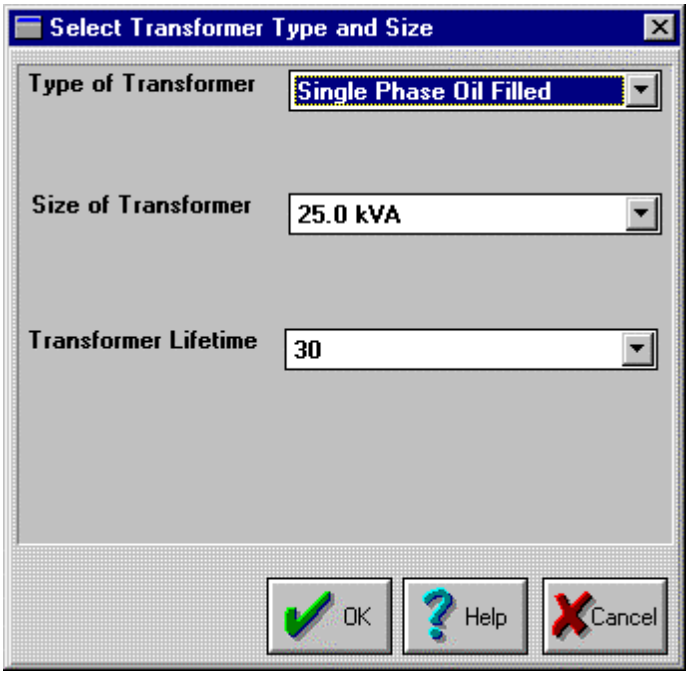


Figure 125: Select Transformer Type and Size dialog box

Three drop down lists are presented in this dialog. The top box shows the type of transformer, the middle box shows the size of the transformer in kVA, and the bottom box shows the transformer life in years. Any of the three parameters may be changed by clicking on

in the Bid Evaluation screen.

Step 4. Edit the Load Characteristics

The fourth step is to edit the default load characteristics are created in DTCEM based on the Model Losses (Disco) calculation method and the type and size of the transformer. These characteristics may be edited by double clicking on the cream colored cell corresponding to the **Load Characteristics** at the top of the Bid Evaluation screen. The "Load Characteristics" box pops up as shown in Figure 126 below.

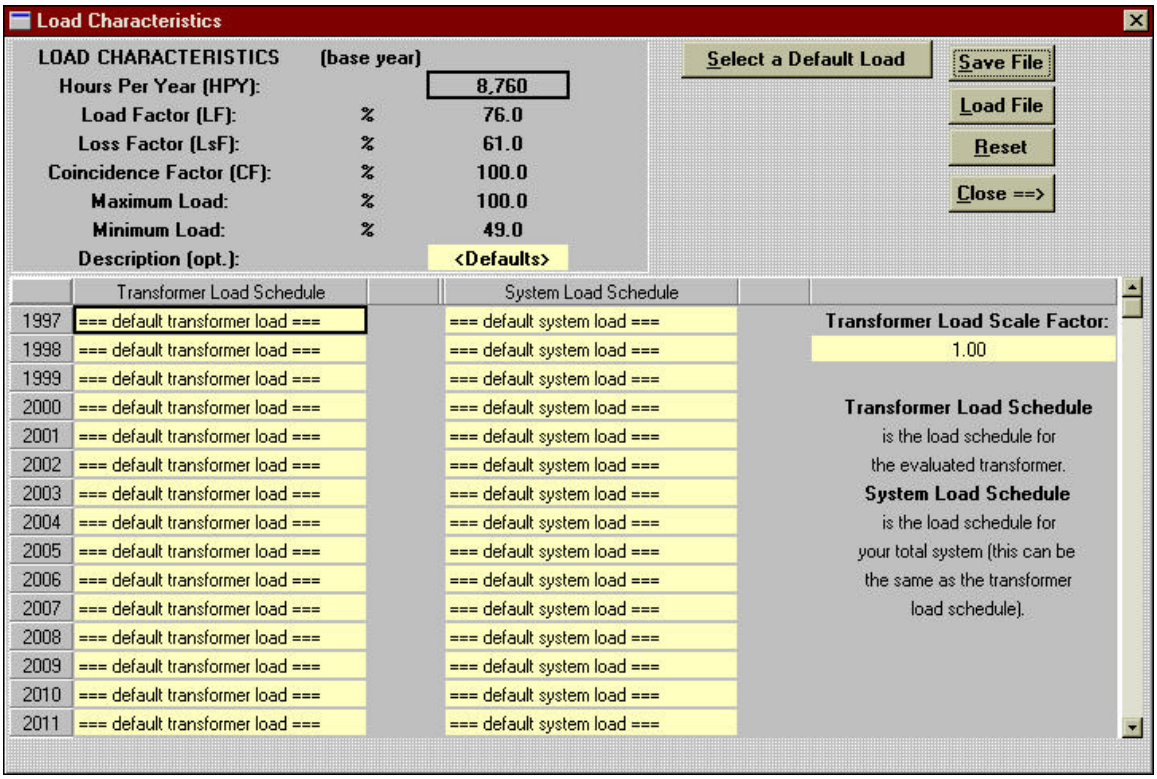


Figure 126: Load Characteristics screen

The top part of this screen lists the default load characteristics.

- Hours Per Year (page 107
- 107)
  Loss Factor (page)
- Coincidence Factor (page 106
- 108)
  Minimum Load (page)

In addition to these parameters, a description of the load characteristics may be entered in the Description box.

system load profiles. You have two options for creating load profiles that are specific to your transformer and system load. These options are described below:

Create Default Load Schedules

DTCEM has created a series of default load schedules which may be used to model the transformer and system load. These default load schedules may be imported by clicking on the "Select a Default Load" button in the upper right hand corner of the Load Characteristics screen. The **Create a Load Schedule** dialog box pops up as shown in Figure 127 below.

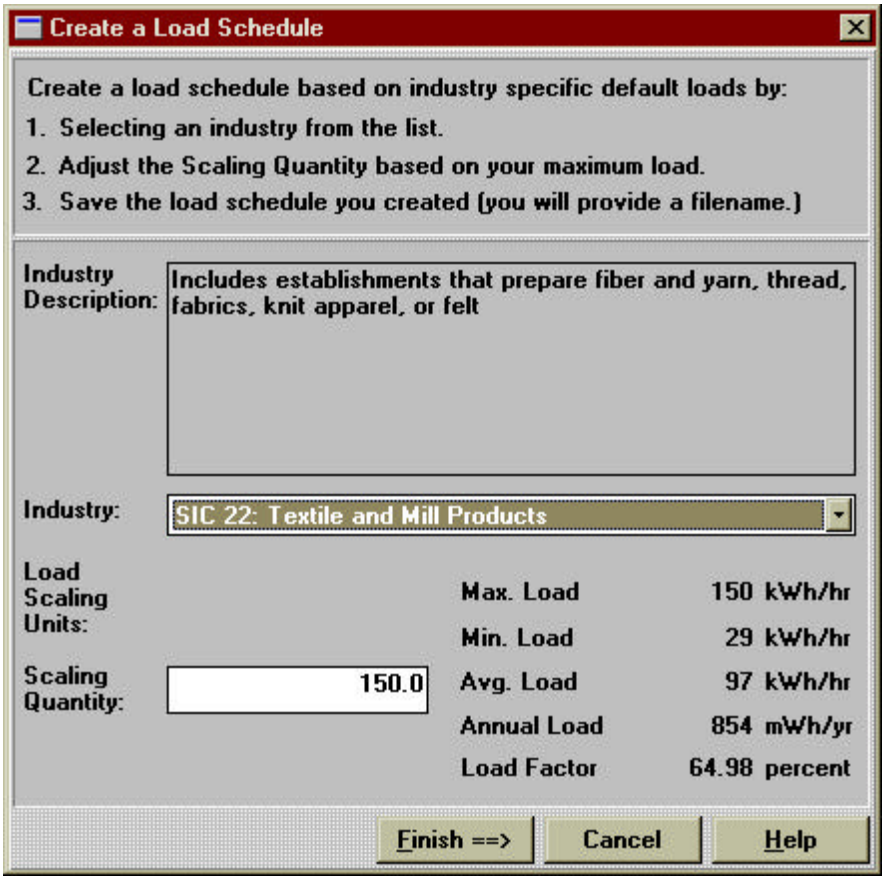


Figure 127: Create a Load Schedule Dialog Box

This dialog box allows you to select from a list of distribution cooperative types in the drop down box. Upon selection, the maximum, minimum, average load, annual load, and load factor values for this type of company are listed in the lower right hand corner of this screen. You may adjust these default load values by entering a scaling factor in the Scaling Quantity box.

When you are finished selecting the company type and scaling the default load factors you should click on the Finish button. DTCEM prompts you to save the default load schedule as a *.lsc file. DTCEM then asks you if the transformer load is equal to the overall system load. Upon selecting Yes or No, the top of the Load Characteristics screen displays the new load factors and the bottom of the Load Characteristics screen lists the new file name that you created.

Import RateVision Load Schedules

While it is possible to select and modify default load schedules as defined above, it is recommended that you enter detailed load schedules in RateVision and import the files into DTCEM for analysis. Detailed RateVision load schedules allow you to more accurately describe the energy usage over the course of a year.

Transformer and system load schedules may be imported by double clicking in one of the cream colored cells in the corresponding columns at the bottom of the Load Characteristics screen. Select the desired Load Schedule file (*.lsc) in the "Select a Load Schedule" dialog box and click OK. The name of the load schedule is displayed in each cell of the column selected (Figure 128). Also, changes to the load characteristics are reflected in the table at the top of the screen. If necessary, the transformer load scale factor (see page 109) may be adjusted to adjust the load factors up or down.

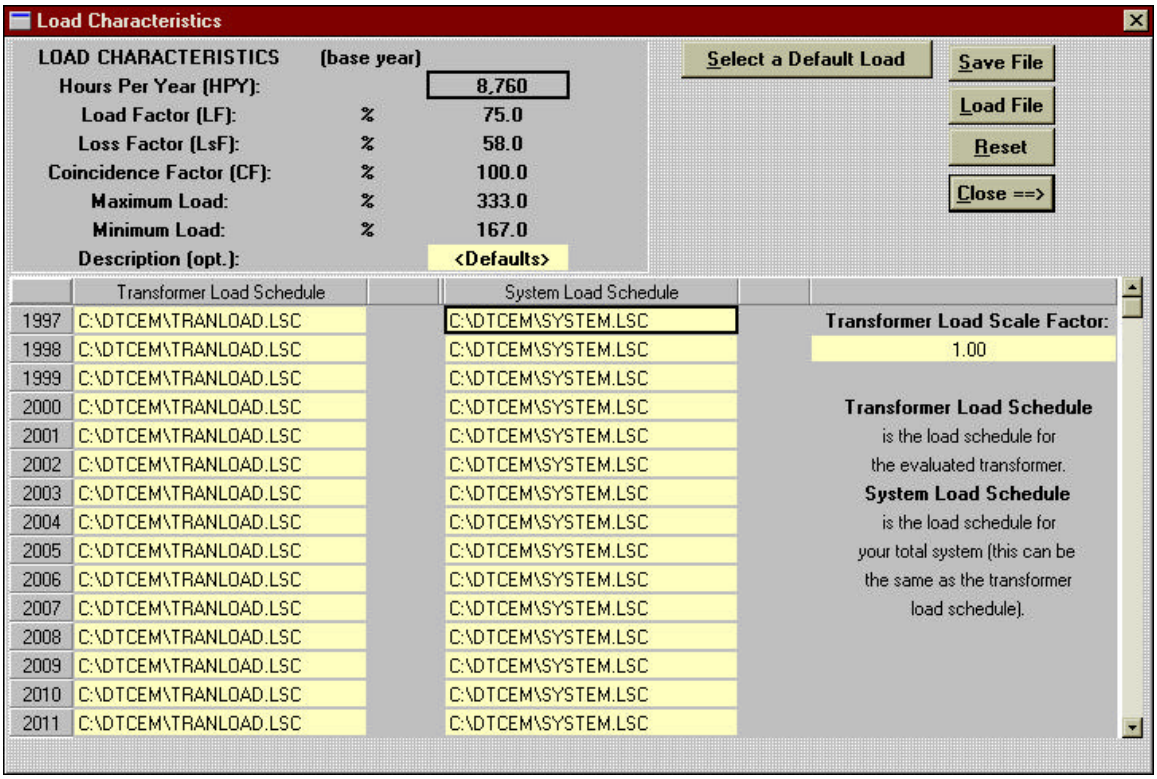


Figure 128: Load Characteristics screen showing imported load schedule file names

This screen may be closed by clicking on the Close button.

Step 5. Edit the Cost Factors

The next step is to enter the cost of power by selecting a RateVision rate schedule. You may select the rate schedule by double clicking on the cream colored cell corresponding to **Cost Factors** at the top of the Bid Evaluation screen. The "Cost Factors" box pops up as shown in Figure 130 below.

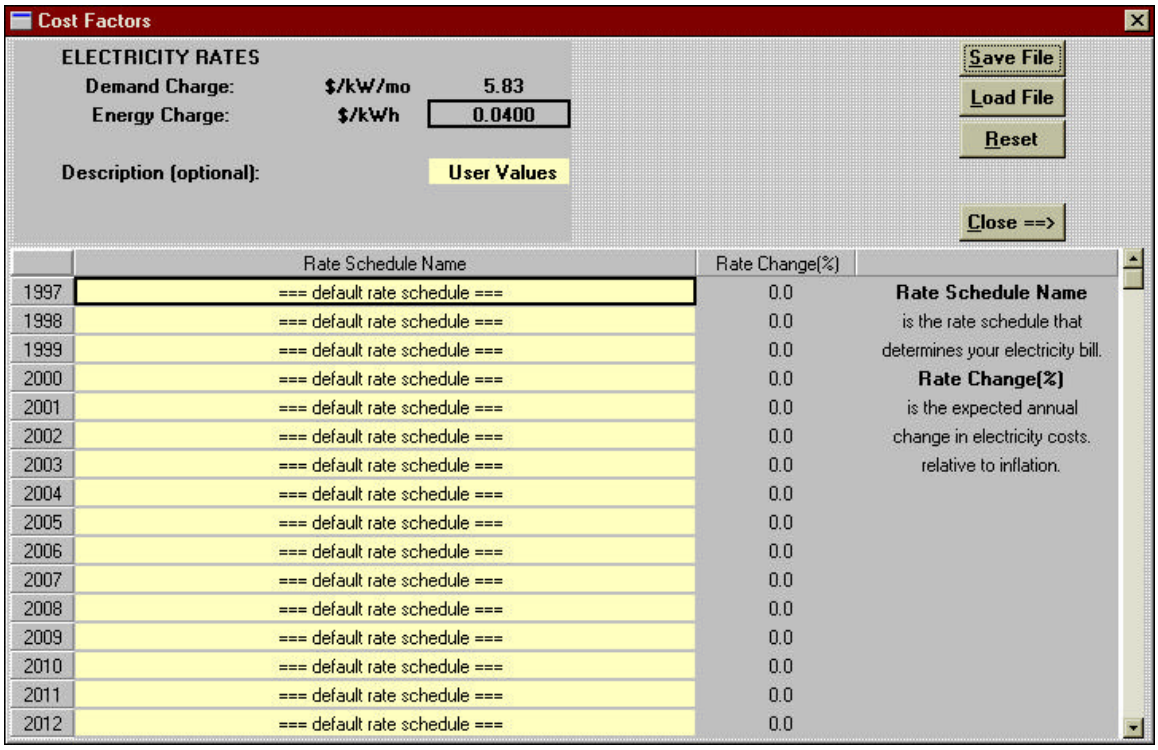


Figure 130: Cost Factors screen

The top part of this screen lists the default cost factors.

- Demand Charge (page 106)
- Energy Charge (page 107)

These values cannot be directly edited. These values are initially calculated using a default rate schedule. You may accept these defaults or you may import a defined rate schedule which will calculate these values over the lifetime of the transformer. In addition to these parameters, a description of the cost factors may be entered in the Description box.

A rate schedule file (*.rat) may be imported by double clicking in one of the cream colored cells in the lower half of the screen. Upon importing a file, the file name is displayed in the cream colored cells for each year of analysis and the demand and energy charge are updated in the upper portion of the screen (Figure 131).

In addition to importing a previously defined rate schedule, you may also wish to add a rate change percent which is the expected average change in electricity costs relative to inflation. To add a rate change, click in one of the cream colored cells in the rate change % column and type the change (e.g., 1.0). If you wish for this value to be applied to each of the years following the current year, double click on the rate change cell with the changed value. In Figure 131, a rate change of 1% per year has been added to each year. This indicates that the user expects the annual electricity costs to be 1% greater than the inflation rate.

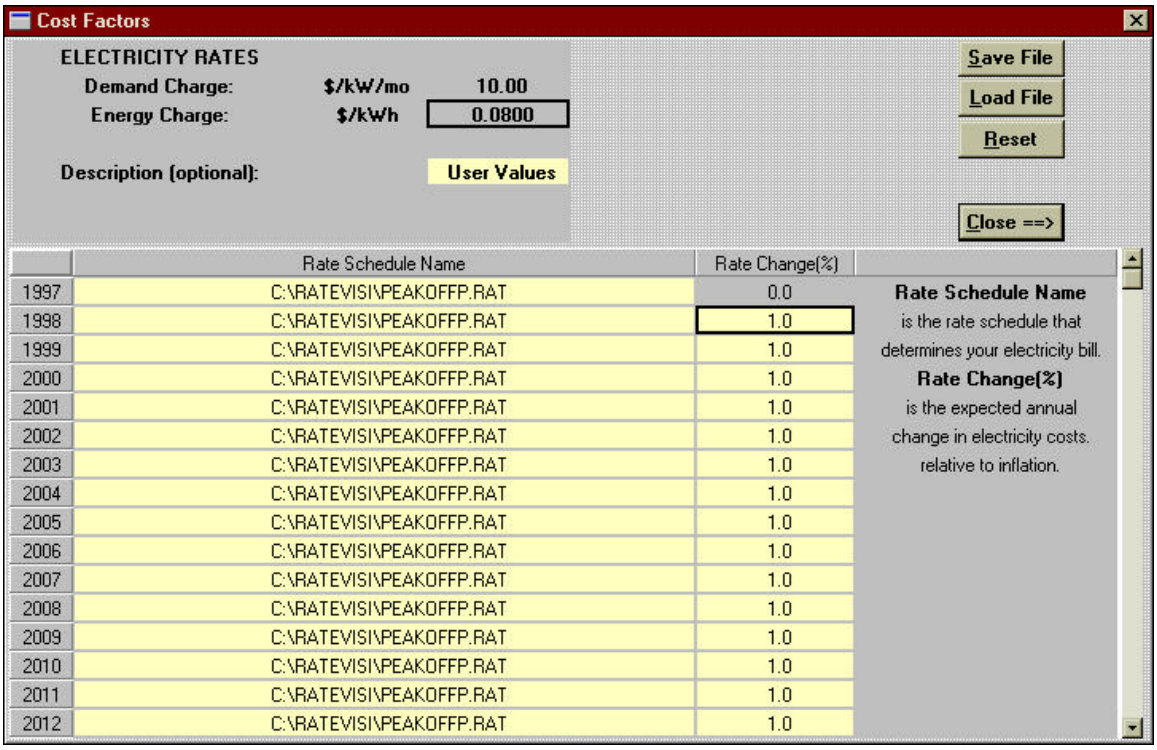


Figure 131: Cost Factors screen showing imported rate schedule file name

This screen may be closed by clicking on the Close button.

Step 6. Enter the Transformer Bids

The last required step in the manual data entry process for distribution companies using the Model Losses (Disco) calculation method is to enter the transformer supplier and price information in the bottom portion of the Bid Evaluation screen. This information may be entered by double clicking in a cream colored cell in one of the rows at the bottom of the Bid Evaluation screen. The "Enter a Figure 132 below:

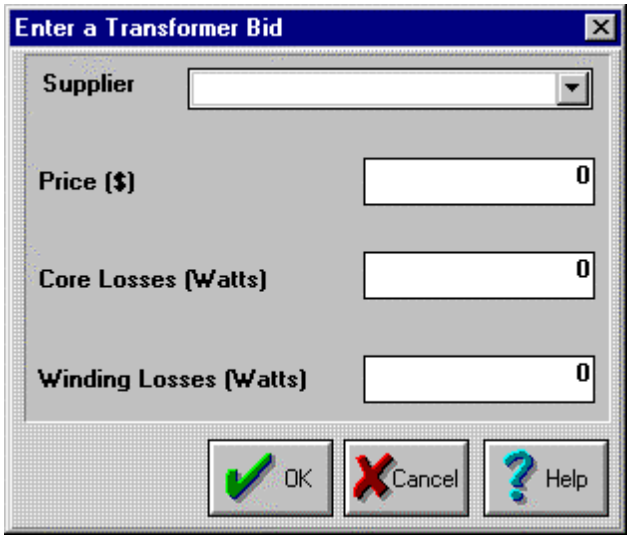


Figure 132: Enter a Transformer Bid dialog box

The information entered in this dialog is displayed in a row in the Bid Evaluation screen. The loss figures are multiplied by their appropriate incremental cost values to estimate the load loss and no-load loss costs. These values are then used to calculate the first year losses and the lifetime losses. As the bids are added to the Bid Evaluation screen, they are ranked and listed based on the lowest total owning cost (TOC).

Step 7. Analyze the Data

The next step is to view the comparative energy costs and benefits for the different bids in the Bid Evaluation screen.

➜ ***Click on the Quick Report icon (Figure 133) on the floating toolbar.***

You are first shown the "Report Control Panel" (Figure 134) in which you may select the number of transformers you wish to purchase, the method by which you want to sort the transformers, the transformer bids you wish to analyze, and the transformer bid which you wish to serve as the "base case".

Figure 133: Quick Report icon

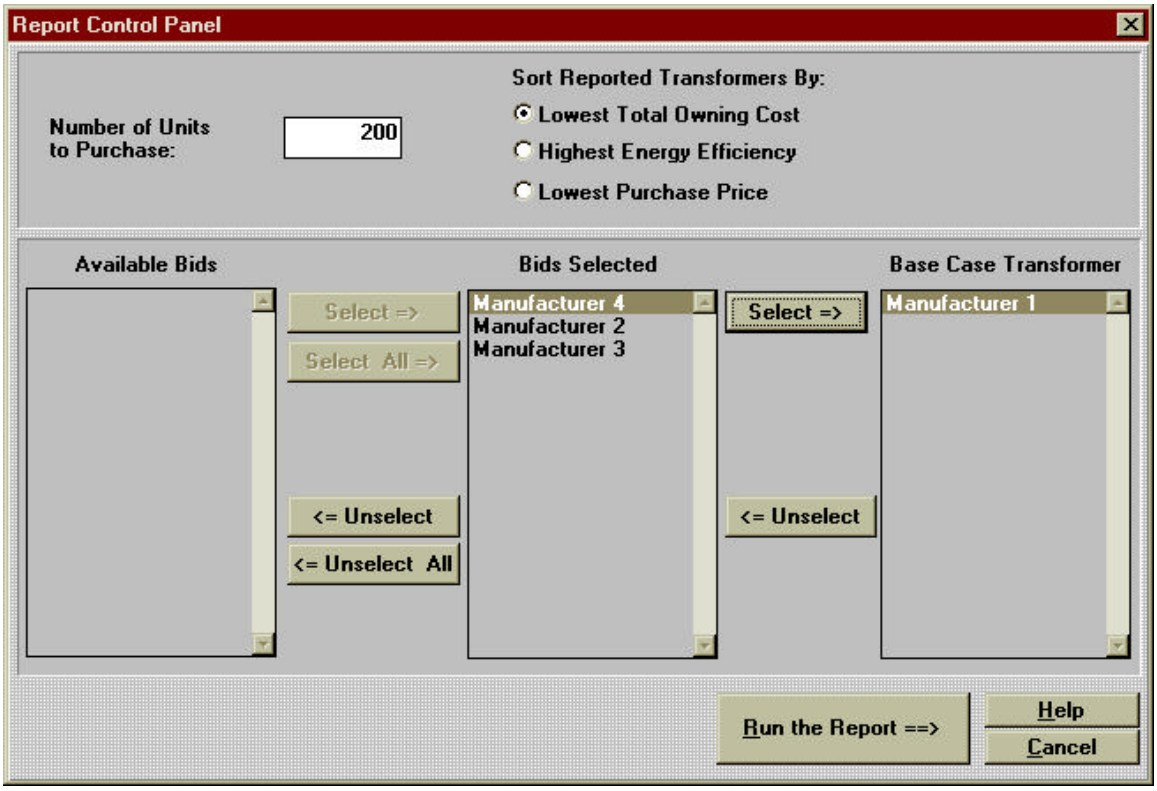


Figure 134: Report Control Panel

Enter the number of units you wish to purchase and the method by which you want to sort the transformer bids. The select the transformer bids you wish to analyze and the transformer bid which you would like to use as the "basecase". The "basecase" transformer should be the transformer you would have purchased prior to running DTCEM. When you have finished entering this information, click on the "Run the Report" button to run the report.

The "Bid Evaluation Report" pops up as shown in Figure 135.

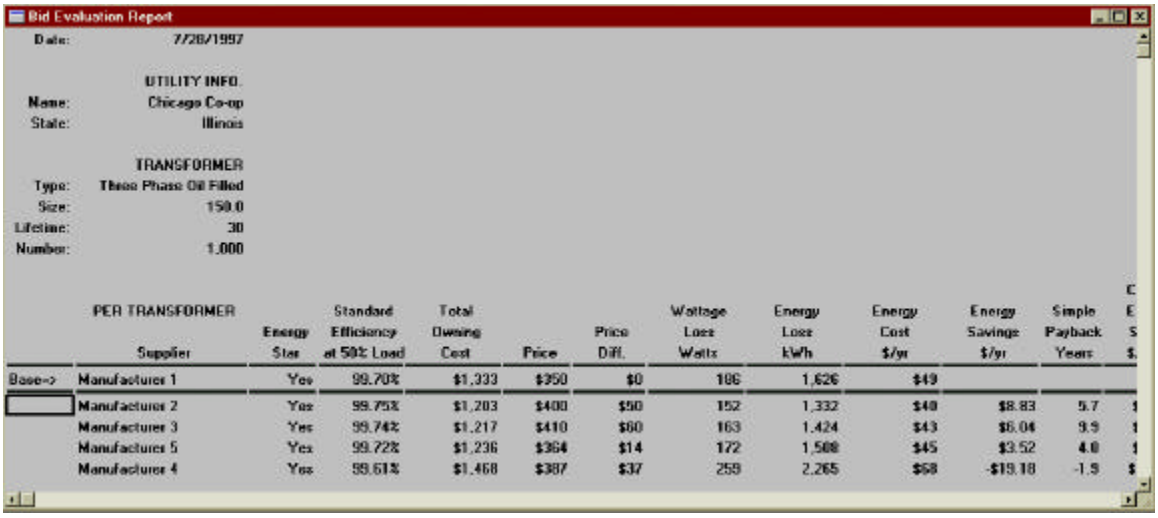


Figure 135: Bid Evaluation Report

This report screen is not maximized when it is displayed. It may be necessary to use the scroll bars on the right side and the bottom of the screen to scroll through the entire report.

The top part of the report contains information about the utility and the transformers. The bottom part of the report contains two tables, both of which analyze the energy costs, benefits, and emissions avoided. These values in the top row of the table are for the "base case" transformer. The remaining rows display values for the other transformers relative to this base case.

It should be noted here that the simple payback may be a negative number. Simple payback is calculated by dividing the price difference by the energy savings/year. The potential scenarios and details what the simple payback in each of these cases means is detailed in Appendix C.

Step 8. Save the Bid Evaluation

After following through Steps 1 through 7 you will have successfully entered the information necessary to analyze transformer bids for a distribution company using the Model Losses (Disco) calculation method. The next step is to save the file such that it can be opened and edited at a later date.

➜ ***Click on the save bid icon (Figure 136) on the toolbar.***

➜ ***Enter the name of the file in the "Select a Filename" box and click on the OK button.***

Figure 136: Save Bid icon

4.4 Other Optional Features

The previous sections describe how to enter the basic information needed to analyze transformer bids using the Model Losses (Disco) calculation method. This section describes in greater detail the RateVision software program and how it can be used with both the "Calc Losses (Disco)" and the "Model Losses (Disco)" calculation methods.

RateVision

RateVision is a program designed to enter and analyze electricity rate schedules and energy usage schedules. These schedules are saved in formats that are compatible with other software programs, including DTCEM, and can be used to analyze various energy saving or producing options within these programs.

Figure 137: RateVision icon

RateVision may be accessed from DTCEM by clicking on the RateVision icon (Figure 137) on the toolbar or by selecting **RateVision** from the **Tools** menu. . By default, DTCEM looks for the RateVision program in your c:\ratevisi directory. You may change this directory if necessary by selecting **Set RateVision Directory** from the **Setup** menu.

More details regarding how to use RateVision is described in the RateVision user's manual.

Load Schedules

A load schedule is a collection of daily load profiles that describes energy use over the course of a year. Individual load profiles list energy usage for each hour of the day. Energy usage typically varies by day of week and time of year.

Calc Losses (Disco): Load schedules may be used to calculate the load factor (LF) and peak responsibility factor (RF) when the calculation method is "Calc Losses (Disco)". Load schedules (*.lsc) may be imported into the calculation worksheets for the LF and RF in the Load Characteristics screen. Both a system load schedule and a transformer load schedule may be imported if desired.

Model Losses (Disco): Load schedules may be used to calculate all of the load factors including the hours per year, load factor, loss factor, coincidence factor, maximum load, and minimum load. Both a system load schedule and a transformer load schedule may be imported if desired.

Rate Schedules

A rate schedule is an agreement between a customer and the utility company that outlines the rates paid for electricity. There are many types of rate schedules using different terminology, values, and calculation methods for four basic components: fixed monthly charge, demand charge, energy charge, and other charge. Together, these four charge elements determine an electricity bill.

Model Losses (Disco): A rate schedule may be used to calculate all of the demand and energy charges used in the calculation of core and winding losses for a distribution cooperative. Rate schedules may be imported into DTCEM as described on page .

CHAPTER 5. REFERENCE

This chapter summarizes the different features of the DTCEM program. Each option is listed in alphabetical order with a short description indicating how to use the feature.

Arrange Icons

When you have one or more DTCEM windows minimized to icons you may wish to arrange the icons so that they are ordered and easy to view. To arrange the icons, select **Arrange Icons** from the **Windows** menu.

Bid Evaluation Floating Toolbar

The bid evaluation floating toolbar (Figure 138) contains several options which allow you to edit the information in the bottom part of the Bid Evaluation table. These options include clear all bids (page 91), delete bid (page 93), edit bid (page 93), quick report (page 94), summary report (page 97) and close (page 100).

Figure 138: Bid Evaluation Floating toolbar

Bid Evaluation Templates

DTCEM allows you to save time when entering multiple bid evaluations by creating default bid evaluation templates. A bid evaluation template consists of some or all of a bid evaluation. This includes the calculation method, transformer type and size, load characteristics, cost factors, and transformer bids. If you plan to use the same basic information in more than one bid you may wish to save this information as a bid evaluation template (*.bdt) file.

Bid evaluation template files (*.bdt) are stored in your c:\dtcem\system directory. A default.bdt file is created for you upon installing the software. You may alter this file as you see necessary and then save it by selecting **File** | **Save as Template** from the menu.

When you click on the new bid icon on the toolbar you will be asked whether you wish to use the default bid evaluation template or a different bid evaluation template. The default bid evaluation template (default.bdt) file is used if you select yes. If you select no, you may select a different *.bdt file.

Capacity Planner (GC & EC)

The capacity planner tool allows you to estimate the avoided costs of generation capacity (GC) and energy capacity (EC). The approach taken by the capacity planner is to develop a base case and change case scenario for providing capacity and energy. The base case represents the costs of providing a certain capacity. The change case is generated by decrementing (lowering) the capacity requirements by some amount (e.g., 10%) and re-estimating the cost of providing the necessary capacity. Because in most cases capacity expansion plans can be delayed by some number of years, the present value costs between the two cases represents the costs avoided by decrementing the system's capacity.

The Capacity Planner may be selected by clicking on the capacity planner icon (Figure 139) or by selecting **Generation & Energy (GC & EC)** from the **Tools** menu. More detailed information describing how to use the features of the Capacity Planner is included on page 44.

Calculation Method

Figure 139: Capacity Planner icon

Core and winding losses are utility specific variables that account for capitalized costs per rated watt at no-load and full-load conditions. The cost of core losses are often referred to as the "A" factor and the cost of winding losses are often referred to as the "B" factor. These values may be derived using utility specific capital, fuel, generation, transmission, operation, and maintenance costs, along with customer demographics. When evaluating a transformer bid with DTCEM you should determine the calculation method which is to be used calculate these variables. The choices you have in DTCEM are:

1. Enter Losses Directly: use core and winding losses which have already been calculated.
2. Calc Losses (Generator): calculate core and winding losses for a generating utility.
3. Calc Losses (Disco): calculate core and winding losses for a distribution company without generation.
4. Model Losses (Disco): calculate core and winding losses for a distribution company using previously defined RateVision rate and load schedules.

You may select one of the options by double clicking on the cream colored cell next to the **Calculation Method** text at the top of the bid evaluation screen. The "Select the Calculation Method" dialog box is presented as shown in Figure 140 below:

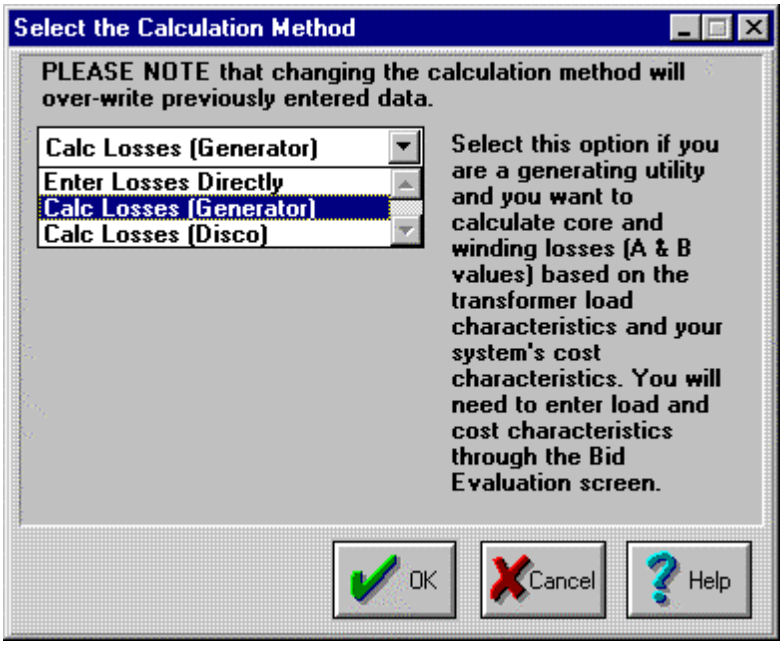


Figure 140: Calculation method dialog box

You should select one of the three options from the pick list. Click on OK to save and continue. Based on your selection, you may need to enter **Load Characteristics** and **Cost Factors** to calculate the A and B factors and the total transformer costs. Detailed information describing how to enter this information for each of the three calculation methods is contained in Chapters 2, 3, and 4.

Cascade Windows

When you have more than one document window open (but not minimized), you can select **Cascade** from the **Window** menu or press Shift+F5 to restore and arrange the open windows. Cascaded windows overlap so that the title bar of each window is displayed. Click on the title bar to view a window's contents.

Clear All Bids

To clear all of the bids from the lower part of the Bid Evaluation table click on the Clear All icon (Figure 141) in the bid evaluation floating toolbar (page 90).

Figure 141: Clear all icon

Close All Windows

To close all open windows, select **Close All** from the **Window** menu.

Close Bid Evaluation Screen

To close the bid evaluation table, click on the Close icon (Figure 142) in the bid evaluation floating toolbar (page 90).

Figure 142: Close icon

Close Current Window

To close the current or active window, select **Close Current Window** from the **Window** menu, and double-click on the upper left hand corner. Alternatively, select **Close** from the **Control** menu.

Cost Data

To edit the default costs associated with the capacity and fuels, select **Cost Data** from the **Setup** menu. You have two choices, **Capacity Costs** and **Fuel Costs**. Both are tables as shown in Figure 143 and Figure 144 below:

Default Capacity Costs

New Power Plant:	$500.00	per kW
Expand Power Plant:	$400.00	per kW
Extend Existing Plant's Life:	$400.00	per kW
Purchase Power:	$600.00	per kW
Purchase DSM Reductions:	$400.00	per kW
Purchase Landfill Power:	$0.00	per kW
Purchase Coalbed Methane Power:	$0.00	per kW
Purchase Manure Methane Power:	$0.00	per kW
Purchase Cogenerated Power:	$200.00	per kW
Purchase Other Green Power:	$200.00	per kW

Figure 143: Default Capacity Costs Table

Default Fuel Costs

Natural Gas Cost:	$0.05	per kWh
Oil Cost:	$0.05	per kWh
Coal Cost:	$0.05	per kWh
Nuclear Fuel Cost:	$0.05	per kWh
Hydroelectric Cost:	$0.05	per kWh
Landfill Gas Cost:	$0.05	per kWh
Coalbed Methane Cost:	$0.05	per kWh
Manure Biogas Cost:	$0.05	per kWh
Cogenerated Power Cost:	$0.05	per kWh
Recuring Cost:	$0.05	per kWh

Figure 144: Default Fuel Costs Table

Any of the default costs in the cream colored boxes may be edited if necessary. Simply click into the box and type the correct value. These changes will be permanently saved. If you wish to reset one of the values to the defaults, click in the cream colored cell you wish to reset and click on the reset one icon (Figure 145) in the floating toolbar. If you wish to reset all of the values to the defaults, click on the reset all icon (Figure 146) on the floating toolbar.

Figure 145: Reset one icon

The natural gas, oil, and coal default fuel costs may be calculated using the heat rate calculator dialog. To access the Heat Rate Calculator Dialog (Figure 147), double click in the cream colored cell corresponding to either the natural gas, oil, or coal cost.

Figure 146: Reset all icon

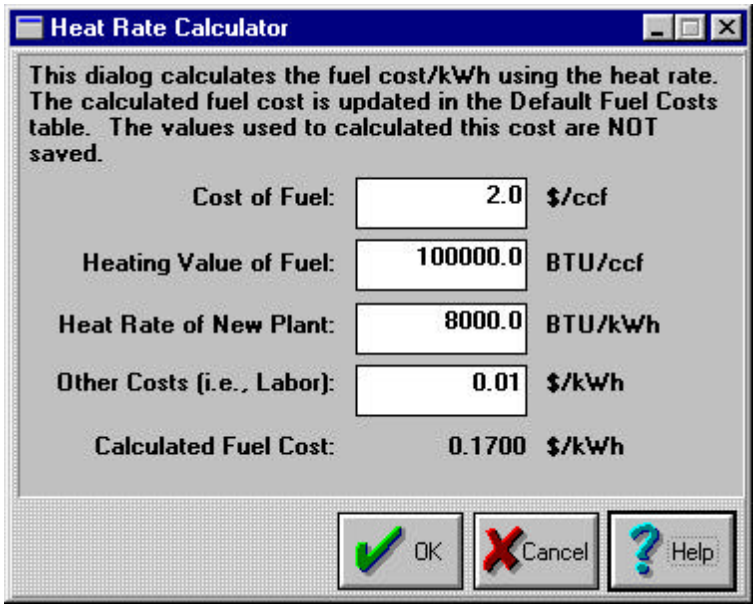


Figure 147: Heat Rate Calculator Dialog Box

The Heat Rate Calculator calculates the cost of fuel in $/kWh based on the following equation:

(CF / HV * HRNP) + OC

where:

CF	=	Cost of the fuel (mass)
HV	=	Heating Value of the fuel
HRNP	=	Heat Rate of the New Plant
OC	=	Other Costs (i.e., Labor)

Any of these values may be edited in this screen if necessary. Note that these values are NOT saved upon exiting the dialog. Only the calculated cost of fuel/kWh is saved and updated in the Default Fuel Costs Table.

Click on the OK button to save and exit this dialog.

You may exit the Default Fuel Cost and Default Capacity Cost tables by double clicking in the upper left hand corner or the screen.

Delete Bid

To delete one of the bids from the bottom part of the Bid Evaluation table click in the row containing the bid to be deleted and then click on the Delete icon (Figure 148) in the bid evaluation floating toolbar (page 90).

Figure 148: Delete icon

Edit Bid

To edit one of the bids in the bottom part of the Bid Evaluation table, click in the row containing the bid to be edited and then click on the Edit icon (Figure 149) in the bid evaluation floating toolbar (page 90).

Figure 149: Edit icon

Exit

To exit the DTCEM Program, click on the Exit icon (Figure 150) on the toolbar or select Exit from the File menu. *Note: Any work which has not been saved prior to exiting will be erased. Be sure to save any important work before exiting.*

Figure 150: Exit icon

Financial Data

To enter basic financial data which will be used in the cost and benefit calculations, select **Financial Data** from the **Setup** menu. The "Enter Financial Factors" dialog box pops up as shown in Figure 151:

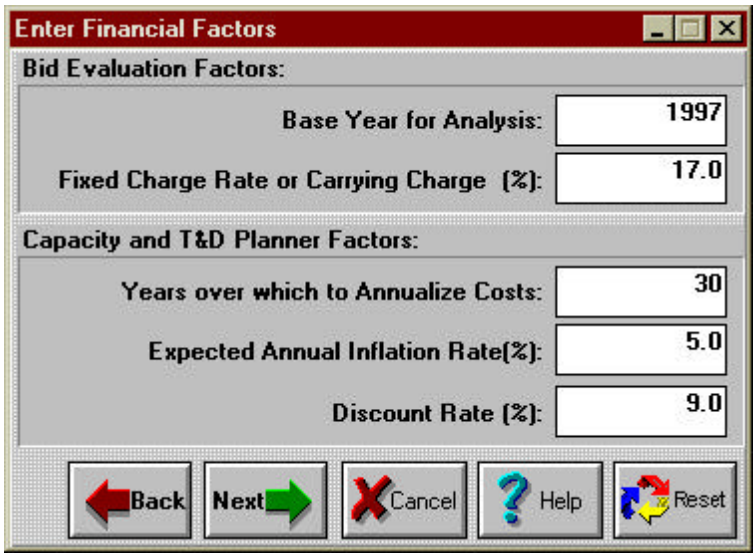


Figure 151: Financial Data Dialog Box

The following information should be entered in this screen:

- Base year for the analysis
- Annualization years (years for levelizing values)
- Annual inflation rate (%)
- Discount rate (%)
- Fixed charge rate (%)

Click on OK to save this information.

Help About

Select **About** from the **Help** menu to see information about your version of DTCEM (Figure 152).

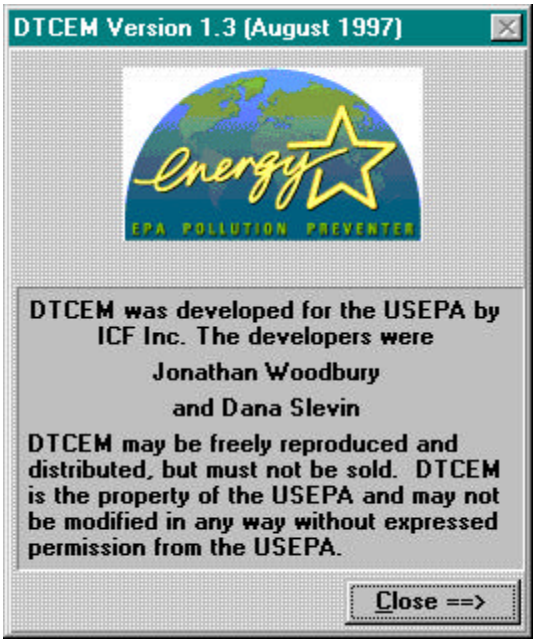


Figure 152: DTCEM About Screen

Help Contents

Select **Contents** from the **Help** menu or press F1 to see a list of the help sections contained in the DTCEM help system. These sections are arranged in the same manner as this manual, by menu topic.

Since Help is actually a window, you can use the Windows features to move around. The DTCEM Help system contains hypertext jump topics which move you to other topics and pop-up topics which display definitions or other information. These jump topics and pop-up topics are green and may be selected by clicking on the text.

Help Keyword

Help is accessible in DTCEM for any number or value in any of the tables. While in a DTCEM table, you may access context specific help for any of the numbers by clicking in the cell and then clicking the right mouse button.

Maximize Current Window

To maximize the current or active window, select **Maximize Current Window** from the **Window** menu, and click on the maximize (up arrow) button in the upper right hand corner. Alternatively, select **Maximize** from the **Control** menu.

Minimize All Windows

To minimize all open windows to icons, select **Minimize All** from the **Window** menu. The minimized icons are displayed on the bottom of the screen.

New Bid

To evaluate a set of bids on a particular transformer rating, click the New bid icon (Figure 153) on the toolbar or select **New Bid Evaluation** from the **File** menu. You may have more than one new bid evaluation window open at one time.

Figure 153: New bid icon

Open Bid

To open an existing bid evaluation which has been saved, click the Open Bid icon (Figure 154) on the toolbar or select **Open Existing Bid Evaluation** from the **File** menu. Type the name of the file you wish to open in the Filename box, or select the file you want to open using the drive, directory, and file lists.

Figure 154: Open bid icon

Print

To print a hard copy of the bid evaluation, select **Print** from the **File** menu or click on the Print icon (Figure 155) on the toolbar. This report is generated in the DTCEM word processor. Upon generation you may edit the report as needed. You may save this report by selecting Save from the DTCEM word processor File menu. To exit this word processor, double click in the upper left hand corner of the screen.

Figure 155: Print icon

Quick Report

To view a report showing the comparative energy costs and benefits for the different bids in the Bid Evaluation click on the Quick Reports icon (Figure 156) in the bid evaluation floating toolbar (page 90). *Note: At least two bids should be entered in the lower portion of the Bid Evaluation table before running this report.*

Figure 156: Quick report icon

You will first be shown the "Reports Control Panel" (Figure 157) in which you may select the number of transformers you wish to purchase, the method by which you want to sort the transformers, the transformer bids you wish to analyze, and the transformer bid which you wish to serve as the "base case."

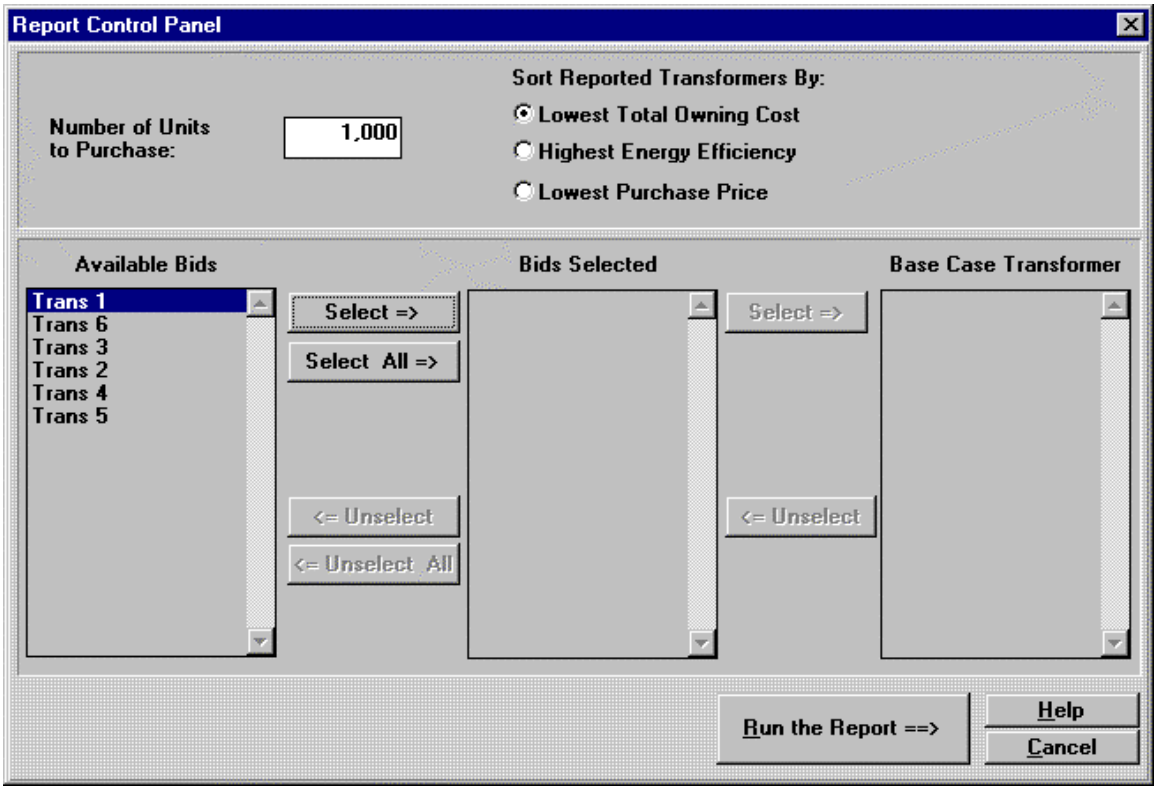


Figure 157: Reports Control Panel

When you have selected all of the information needed you may view the report by clicking on the "Run the Report" button in the Control Panel.

The top part of the report contains information about the utility and the transformers. The bottom part of the report contains two tables, both of which analyze the energy costs, benefits, and emissions avoided. These values in the top row of the table are for the "base case" transformers. The remaining rows display values for the other transformers relative to this base case.

You may print a hard copy of this report by clicking on the print icon on the toolbar. To close this report, double click on the upper left hand corner.

RateVision

RateVision is a program designed to enter and analyze electricity rate schedules and energy usage schedules. These schedules are saved in formats that are compatible with other software programs, including DTCEM, and can be used to analyze various energy saving or producing options within these programs.

Figure 158: RateVision icon

RateVision may be accessed from DTCEM by clicking on the RateVision icon (Figure 158) on the toolbar or by selecting **RateVision** from the **Tools** menu. . By default, DTCEM looks for the RateVision program in your c:\ratevisi directory. You may change this directory if necessary by selecting **Set RateVision Directory** from the **Setup** menu.

More details regarding how to use RateVision is described in the RateVision user's manual.

Restore All Windows

To restore all windows to the maximum size, select **Restore All** from the **Window** menu.

Save Bid

To save a bid evaluation, click the Save Bid icon (Figure 159) on the toolbar or select **Save Bid Evaluation** from the **File** menu. When using Save, the copy you have been working on replaces the saved copy on disk. If you have not saved the session before, DTCEM will prompt you to name it.

Figure 159: Save bid icon

Save As Template

DTCEM allows you to save time when entering multiple bid evaluations by creating default bid evaluation templates. A bid evaluation template consists of some or all of a bid evaluation. This includes the calculation method, transformer type and size, load characteristics, cost factors, and transformer bids. If you plan to use the same basic information in more than one bid you may wish to save this information as a bid evaluation template (*.bdt) file.

Bid evaluation template files (*.bdt) are stored in your c:\dtcem\system directory. A default.bdt file is created for you upon installing the software. You may alter this file as you see necessary and then save it by selecting **Save as Template** from the **File** menu.

Set RateVision Directory

RateVision is a user friendly software program designed to enter and analyze electricity rate schedules and energy usage schedules. RateVision may be accessed through DTCM. By default, DTCEM looks for the RateVision program in your c:\ratevisi directory. You may change this directory if necessary by selecting **Set RateVision Directory** from the **Setup** menu.

Summary Report

The summary report is similar to the Quick Report in that it shows the comparative energy costs and benefits for the different transformer bids in the Bid Evaluation table. This report, however, may be easily edited in any word processor and printed. To run the summary report, click on the Summary Report icon (Figure 160) in the bid evaluation floating toolbar (page 90).

Figure 160: Summary report icon

Like the Quick Report, you are first shown the Reports Control Panel (Figure 157) in which you may select the number of transformers you wish to purchase, the method by which you want to sort the transformers, the transformer bids you wish to analyze, and the transformer bid which you wish to serve as the "base case."

When you have selected all of the information needed you may view the report by clicking on the "Run the Report" button in the Control Panel.

The Summary Report is displayed in DTCEM's word processor. This file is called "reports.rtf." It is in rich text format which allows it to be opened in any word processor. You may edit this file or clean it up as necessary. This report contains a series of tables showing general information, technical parameters, and financial parameters regarding the transformer bids.

DTCEM's word processor may be closed by double clicking on the upper left hand corner.

Tile Windows

When you have more than one document window open (but not minimized), you can select **Tile** from the **Window** menu or press Shift+F4 to restore and arrange the open windows. Tiled windows are arranged on the screen with no overlapping. To work on one of the windows, click on the title bar of the desired window.

Toggle Windows

To toggle between open windows, click on CONTROL + F6. This is not a menu option in DTCEM however it is a Windows feature and may be used in DTCEM as it may be used in any other Windows program.

Transformer Size and Type

Regardless of the calculation method, the type, size, and lifetime of the transformer for which the bids are being evaluated must be entered. This information may be entered by double clicking on either the **Transformer Size** or **Transformer Type** cream colored box at the top of the Bid Evaluation table. The "Select Transformer Type and Size" dialog box pops up as shown in Figure 161 below.

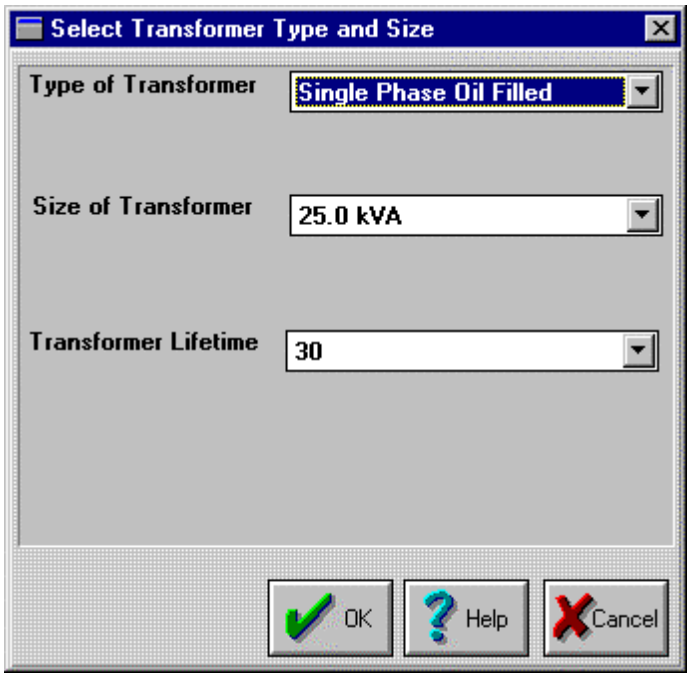


Figure 161: Transformer Type and Size dialog box

Three drop down lists are presented in this dialog. The top box shows the type of transformer, the middle box shows the size in kVA, and the bottom box shows the transformer life. Any of the three parameters may be changed by clicking on the arrow to the right of the edit box. When you are finished, click on the OK button to exit. The changed size and/or type will be reflected in the bid evaluation screen.

Transformer Supplier and Price Information

The Transformer Supplier and Price Information comprises the information in the bottom portion of the Bid Evaluation screen. Specific information for each transformer is needed to perform the actual bid evaluation including:

- Supplier's name
- Price
- Core Losses (Watts)
- Winding Losses (Watts)

These characteristics may be entered by double clicking in a cream colored cell in one of the rows of the Bid Evaluation Table. The "Enter a Transformer Bid" dialog pops up as shown in Figure 162 below:

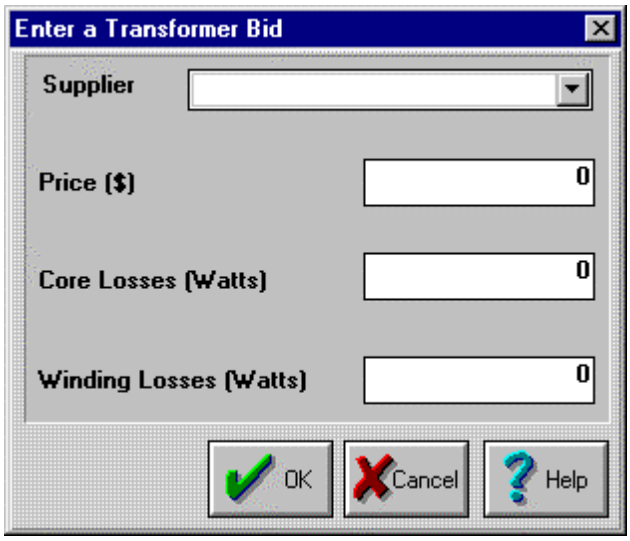


Figure 162: Transformer Bid Dialog

The information entered in this dialog is displayed in a row in the Bid Evaluation table. The loss figures are multiplied by their appropriate incremental cost values to estimate load loss and no-load loss costs. These values are used to calculate the first year losses and the lifetime losses. As the bids are added to the Bid Evaluation table, they are ranked and listed based on the lowest total owning cost (TOC).

Transmission/Distribution Planner (TD)

The Transmission/Distribution Planner tool estimates the avoided cost of transmission and distribution capacity. Unlike the approach taken by the Capacity Planner tool which relies on projected future costs, the Transmission/Distribution Planner relies on historical information to estimate the incremental cost of providing transmission and distribution capacity. The reason for the difference in approach is the difficulty in projecting future costs for transmission and distribution capacity. The historical data necessary for the approach used by the Transmission/Distribution Planner is generally available at most utilities. However, the applicability of these historical costs as the basis for estimating future incremental transmission and distribution capacity costs should be carefully considered.

Figure 163: Trans/Dist Planner icon

To start the Transmission/Distribution Planner, click on the Trans/Dist Planner icon (Figure 163) on the toolbar or choose **Transmission & Distribution (TD)** from the **Tools** menu. More information about using the Transmission/Distribution Planner may be found on page 50.

Utility Information

To enter basic information about your utility, click on the setup icon (Figure 164) on the toolbar or select **Utility Information** from the **Setup** menu. The "Utility Information" dialog box pops up as shown below in Figure 165:

Figure 164: Setup icon

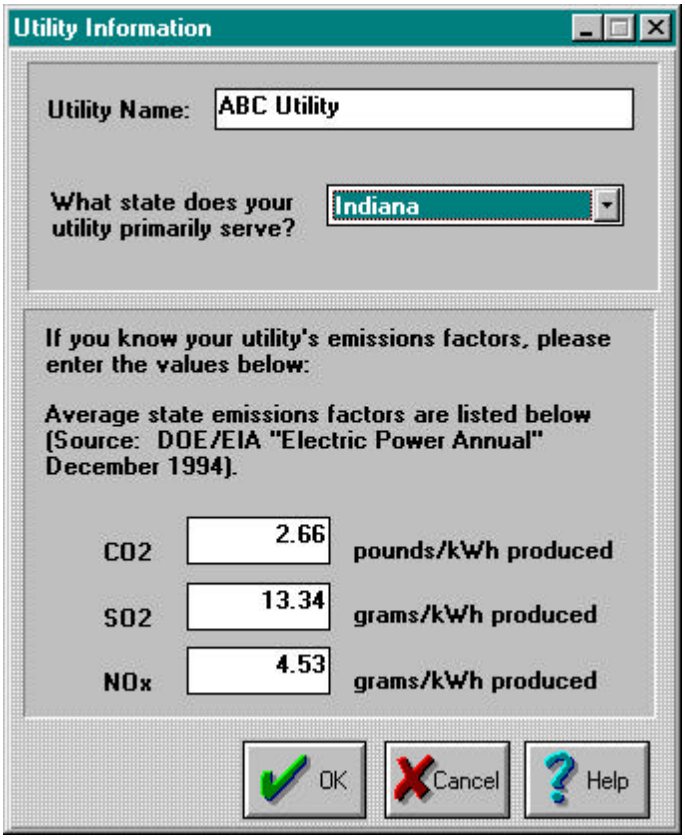


Figure 165: Utility Information Dialog Box

The following information should be entered in this screen:

- Name of utility
- State primarily served by utility
- Emissions factors (for CO_2, SO_2, and NO_x)

Note: Average state emissions factors are calculated from DOE/EIA "Electric Power Annual", December 1994.

Click on OK to save this information.

APPENDIX A: FREQUENTLY ASKED QUESTIONS

How can I save some of the information in the Bid Evaluation so I can use it later?

DTCEM allows you to save time when entering multiple bid evaluations by creating default bid evaluation templates. A bid evaluation template consists of some or all of a bid evaluation. This includes the calculation method, transformer type and size, load characteristics, cost factors, and transformer bids. If you plan to use the same basic information in more than one bid you may wish to save this information as a bid evaluation template (*.bdt) file.

Bid evaluation template files (*.bdt) are stored in your c:\dtcem\system directory. A default.bdt file is created for you upon installing the software. You may alter this file as you see necessary and then save it by selecting **Save as Template** from the **File** menu.

When you click on the new bid icon on the toolbar you will be asked whether you wish to use the default bid evaluation template or a different bid evaluation template. The default bid evaluation template (default.bdt) file is used if you select yes. If you select no, you may select a different *.bdt file.

Why do I get different results when I open a previously saved bid evaluation file?

Transformer bid files (*.bid) include information regarding the type and size of transformer desired, the calculation method used, the load characteristics and cost factors, and the individual bids for the transformer. These files do not include **Financial Data** (page 94) or **Utility Information** (page 100). If the results of a previously saved bid evaluation file appear to change, these changes are most likely the result of changed financial factors which are used in the calculations.

In the reports, how can I change the number of transformers I wish to purchase?

The number of transformers you wish to purchase is entered in the **Report Control Panel**. This screen precedes both the **Quick Report** (page 96) and the **Summary Report** (page 98).

What are rate schedules and load schedules?

Rate schedules and load schedules are used to calculate the core and winding losses when the selected calculation method is **Model Losses (Disco)** (page 77). Rate schedules include information regarding the rates paid for energy including the demand and energy charges. Load schedules include information regarding the energy usage.

Rate schedules and load schedules may be created in the RateVision program (page 89). To access RateVision, click on the RateVision button on the toolbar.

I am a rural distribution cooperative with a complicated rate schedule. It is impossible for me to determine the levelized demand and energy charges from this schedule. How can I save determine this information from the rate schedule such that I can use it in DTCEM?

Distribution cooperatives and companies have two choices for evaluating transformer bids in DTCEM: **Calc. Losses (Disco)** (page 68) and **Model Losses (Disco)** (page 77). Calc Losses (Disco) requires that the user enter a demand and energy charge which is used to calculate the core and winding losses. While this information may be known or estimated for some distribution companies, other companies may not be able to determine these values from complicated rate schedules. Distribution companies that do not know the levelized demand and energy charges should use the Model Losses (Disco) option to model the rate schedule and determine these values. This requires that the user enter the rate schedule in the RateVision software program (page 89) and then import this *.rat file into the Cost Factors screen.

APPENDIX B: TARGET EFFICIENCIES FOR DISTRIBUTION TRANSFORMERS

Target Efficiencies for 10 kVA Single-Phase Transformers

	A Factor			
B Factor	**$0.00 - $1.99**	**$2.00 - $3.99**	**$4.00 - $5.99**	**> $6.00**
< $0.50	98.17	98.28	98.23	98.28
$0.50 - $0.99	98.23	98.65	98.45	98.36
$1.00 - $1.49	98.26	98.74	98.90	98.83
$1.50 - $1.99	98.38	98.69	98.71	98.81
> $2.00	NA	98.69	98.93	98.94

Target Efficiencies for 15 kVA Single-Phase Transformers

	A Factor			
B Factor	**$0.00 - $1.99**	**$2.00 - $3.99**	**$4.00 - $5.99**	**> $6.00**
< $0.50	98.22	98.33	98.28	98.33
$0.50 - $0.99	98.27	98.70	98.50	98.41
$1.00 - $1.49	98.31	98.78	98.95	98.88
$1.50 - $1.99	98.43	98.73	98.75	98.85
> $2.00	NA	98.74	98.98	98.99

Target Efficiencies for 25 kVA Single-Phase Transformers

	A Factor			
B Factor	**$0.00 - $1.99**	**$2.00 - $3.99**	**$4.00 - $5.99**	**> $6.00**
< $0.50	98.49	98.60	98.55	98.60
$0.50 - $0.99	98.54	98.97	98.77	98.68
$1.00 - $1.49	98.58	99.05	99.22	99.15
$1.50 - $1.99	98.70	99.00	99.02	99.12
> $2.00	NA	99.01	99.25	99.26

Note: Target Efficiencies are expressed at 50 percent load.
Target Efficiencies may change annually.

Target Efficiencies for 37.5-50 kVA Single-Phase Transformers

	A Factor			
B Factor	**$0.00 - $1.99**	**$2.00 - $3.99**	**$4.00 - $5.99**	**> $6.00**
< $0.50	98.64	98.76	98.71	98.75
$0.50 - $0.99	98.70	99.13	98.92	98.83
$1.00 - $1.49	98.73	99.21	99.38	99.31
$1.50 - $1.99	98.86	99.16	99.18	99.28
> $2.00	NA	99.17	99.41	99.42

Target Efficiencies for 75 - 167 kVA Single-Phase Transformers

	A Factor			
B Factor	**$0.00 - $1.99**	**$2.00 - $3.99**	**$4.00 - $5.99**	**> $6.00**
< $0.50	98.98	99.05	98.90	99.26
$0.50 - $0.99	99.02	99.25	99.17	99.01
$1.00 - $1.49	99.19	99.29	99.32	99.46
$1.50 - $1.99	99.11	99.21	99.34	99.40
> $2.00	NA	99.26	99.36	99.59

Note: Target Efficiencies are expressed at 50 percent load.
Target Efficiencies may change annually.

APPENDIX C: SCENARIOS FOR SIMPLE PAYBACK IN BID EVALUATION REPORT

Scenario	Price Diff.	Energy Savings	Simple Payback
1	positive	positive	Payback is positive. The price for the transformer is higher and the energy savings are greater than the basecase. In the short term, the cost is higher but over the life of the transformer, the savings are greater.
2	negative	negative	Payback is positive. The price for the transformer is less and the energy savings are less than the basecase. In the short term, the cost is lower but over the life of the transformer the energy savings will be lower.
3	positive	negative	Payback is negative. The price for the transformer is higher and the energy savings are less than the basecase. This is the least desired scenario. The short term initial costs are higher and the savings over the life of the transformer are less.
4	negative	positive	Payback is negative. The price for the transformer is less and the energy savings are greater than the basecase. This is the best scenario. The short term costs are less and the savings over the life of the transformer are greater.

APPENDIX D: GLOSSARY

Annualized: The annualized cost of transmission and distribution per kW.

A value: The dollar value, expressed in $/Watt, for the power losses that occur as a result of energizing the transformer. It is multiplied by the core (no-load) losses, in Watts, to form one value to obtain the total owning costs associated with no-load losses.

Avoided Cost: The avoided cost of operating the needed capacity using the base and change case scenarios. This value is equal to the present value difference divided by 1,000 and multiplied by the decrement.

Avoided Cost of Energy (EC): The levelized avoided (incremental) cost for the next kWh produced by the utility's generating units. It consists of a fuel component and a variable operations and maintenance component.

Avoided Cost of Generation Capacity (GC): The incremental cost of adding an additional kW of generating capacity to the utility's system. There may be multiple scenarios for the installation of new capacity, and the avoided cost typically represents the costs (or the savings) from using the least costly scenario.

Avoided Cost of System Capacity (SC): The levelized avoided (incremental) cost of generating transmission and distribution. The avoided cost of system capacity consists of two components: avoided cost of Generation Capacity (GC) and the avoided costs of Transmission and Distribution Capacity (TD). SC = GC + TD

Avoided Cost of Transmission and Distribution Capacity (TD): The incremental cost of adding an additional kW of transmission and distribution capacity to the utility's system. There may be multiple scenarios for the installation of new T&D capacity, and the avoided cost typically represents the costs (or the savings) from using the least costly scenario.

B value: The dollar value, expressed in $/Watt, for the power losses due to electric load on the system served by the transformer. It is multiplied by the winding (load) losses to form one value to obtain the total owning costs associated with the load losses.

Bid Price: The purchase price to acquire the transformer from the manufacturer. Transformer manufacturers provide this information when responding to utility requests for quotation.

Capital Recovery Factor: A factor that, when multiplied by the principal amount of a loan, determines the annual constant payment needed to repay the loan with interest in a given number of years.

Change-out Loading: The percentage of peak loading that the transformer reaches when it is removed from service. Values are usually well over 100%.

Coincidence Factor: A measure of the diversity of the load on the transformer, expressed as the transformer load at the time of system peak load divided by the transformer peak load. (Kt/Kp)..

Core Losses: Core losses, or no-load losses, are the excitation losses at rated voltage when the transformer is not supplying any load. Core losses occur on all energized transformers and are continuous, independent of load.

Cost of Capital: The composite cost which shows the value of the return to an investor, consisting of a combination of interest rate, bond rate, and/or dividends. It is also known as the minimum acceptable return. The cost of capital is a component of the fixed charge rate.

Decrement: The number of gigaWatt hours which is estimated to predict the change case avoided cost of energy or the number of kW used to predict the change case avoided cost of capacity.

Demand Charge: The demand charge is the per kW of electricity used. These charges typically vary by time of year and peak utility season. In this screen you should enter the levelized demand charge in dollars per kW per month in the corresponding cream colored box.

Demand Side Management (DSM): The planning, implementation, and monitoring of utility activities designed to encourage consumers to modify the patterns and/or amount of electricity usage, including the timing and level of electricity demand.

Discount rate: The interest rate used to convert future payments into present values.

EC (Abbreviation for Avoided Cost of Energy): The levelized avoided (incremental) cost for the next kWh produced by the utility's generating units. It consists of a fuel component and a variable operations and maintenance component.

Energy Charge: The energy charge is the cost per kWh of electricity used. These charges vary by both time of year, time of day, and amount used (block rates). In this screen you should enter the average energy charge in dollars per kWh.

ENERGY STAR Transformer Program: A voluntary, EPA-sponsored program to recognize electric utilities which make a commitment to purchase high-efficiency distribution transformers. The recognition comes in the form of public outreach campaigns to highlight ENERGY STAR Partners' commitment to saving energy and reducing associated air emissions. In addition, the EPA will help with the development of technical resources to assist utilities' efforts to optimize transformer purchases.

Equivalent Annual Peak Load (PL2): The levelized annual peak load seen by the transformer that is equivalent to an initial peak load with an estimated load growth rate and a maximum allowable load before change out is required.

FCR (Abbreviation for Fixed Charge Rate): The cost of carrying a capital investment, or the annual owning cost of an investment as a percentage of the investment. The components of fixed charge rate include the cost of capital, depreciation on the investment, insurance, and taxes (local, income, etc.).

Fixed Charge Rate (FCR): The cost of carrying a capital investment, or the annual owning cost of an investment as a percentage of the investment. The components of fixed charge rate include the cost of capital, depreciation on the investment, insurance, and taxes (local, income, etc.).

GC (Abbreviation for Avoided Cost of Generation): The incremental cost of adding an additional kW of generating capacity to the utility's system. There may be multiple scenarios for the installation of new capacity, and the avoided cost typically represents the costs (or the savings) from using the least costly scenario.

Greenhouse gas: An atmospheric gas which is transparent to incoming solar radiation but absorbs the infrared radiation emitted by the Earth's surface. The principal greenhouse gases are carbon dioxide, methane, and CFCs.

Hours per year (HPY): Hours per year used in the A and B value equations is generally taken as 8,760. However, there may be exceptions, such as transformers connected to irrigation loads. In this case, the transformer may be de-energized a portion of the year, and the value would be less than 8,760.

Inflation Rate: The average annual increase in costs.

Initial Transformer Loading: The peak load percentage that the transformer is serving at beginning of its life.

Intercept: The no load transmission and distribution cost per kW. This value is used in the Transmission/Distribution Planner to calculate the annualized cost of transmission and distribution per kW.

Kilowatt (kW): One kilowatt (kW) is equal to 1,000 watts or the absolute meter kilogram per second unit of power equal to the work done at the rate of one absolute joule per second or to the ate of work represented by a current of one ampere under a pressure of one volt and taken as the standard in the United States.

Kilowatt Hour (kWh): A unit of work or energy equal to that expended by one kilowatt in one hour or to 3.6 million joules.

LF (Abbreviation for Load Factor): The average energy used for a given period of evaluation (year, month, or day).

LM (Abbreviation for Loss Multiplier): A factor used to measure the impact of transmission and distribution system losses on the generation system. For example, if a transformer loses 1,000 kWh/year and the transmission and distribution system losses average 10%, 1,100 kWh (1,000 * (1 + 1.0) will need to be generated to replace these losses.

Load Factor: The average energy used for a given period of evaluation (year, month, or day).

Load losses: See winding losses.

Load schedule: See transformer load schedule and system load schedule.

Loss Multiplier (LM): A factor used to measure the impact of transmission and distribution system losses on the generation system. For example, if a transformer loses 1,000 kWh/year and the transmission and distribution system losses average 10%, 1,100 kWh (1,000 * (1 + 1.0) will need to be generated to replace these losses.

LsF (Abbreviation for Transformer Loss Factor): A ratio of the annual average load losses to the peak value of load losses on the distribution transformer.

Maximum Load: The peak load placed on the transformer as a percentage of the transformer's capacity.

Minimum acceptable return: The lowest interest rate acceptable to a utility for any investment. It may be equal to a discount rate (the interest the utility would have to pay on a loan) or equal to the interest rate being paid to bondholders, or equal to the utility stock dividend yield (if applicable).

Minimum load: The minimum load placed on the transformer as a percentage of the transformer's capacity.

Net growth rate: The growth factor plus the inflation rate.

No-load Losses: See core losses.

Peak load growth rate: The rate at which the peak load on the transformer increases each year.

Peak Responsibility Factor (RF): A measure of the diversity of the load on the transformer. It defines the relationship between the transformer peak load and the transformer load at the time of the utility system peak load.

PL2 (Abbreviation for Equivalent Annual Peak Load): The levelized annual peak load seen by the transformer that is equivalent to an initial peak load with an estimated load growth rate and a maximum allowable load before change out is required.

Present value (PV) Base Case: The present value cost of operating or purchasing the base case capacity in millions of dollars.

Present value (PV) Change: The present value cost of operating or purchasing the change case capacity in millions of dollars.

Present value (PV) Difference: The difference between the present value costs of operating the base case and change case capacities in millions of dollars or the difference between the present value costs of purchasing the base case and change case capacities in millions of dollars.

Rate Schedule: A collection of rate components that account for utility charges throughout the year.

Reserve Margin (Safety Factor): The percentage of capacity required to ensure system reliability above and beyond the utility annual peak kW or MW demand. Typical values are between 15 and 20%.

RF (Abbreviation for Responsibility Factor): A measure of the diversity of the load on the transformer. It defines the relationship between the transformer peak load and the transformer load at the time of the utility system peak load.

SC (Abbreviation for Avoided Cost of System Capacity): The levelized avoided (incremental) cost of generating transmission and distribution. The avoided cost of system capacity consists of two components: avoided cost of Generation Capacity (GC) and the avoided costs of Transmission and Distribution Capacity (TD). SC = GC + TD

Slope: The marginal, or incremental, cost of installing T&D capacity ($/kW).

Supplier: The name of the manufacturer that provided the particular bid.

System Load Schedule: The load schedule that represents the entire load the system services. The system load schedule must be greater than or equal to the transformer load schedule. The system load schedule can be created using the EPA RateVision software.

TD (Abbreviation for Avoided Cost of Transmission/Distribution Capacity): The incremental cost of adding an additional kW of transmission and distribution capacity to the utility's system. There may be multiple scenarios for the installation of new T&D capacity, and the avoided cost typically represents the costs (or the savings) from using the least costly scenario.

Total Owning Cost (TOC): The value that shows the overall cost of a transformer purchase. Most utility cost-effectiveness calculations for transformer purchases determine the total owning cost of the transformer by summing the initial purchasing price of the transformer and the equivalent present value of transformer losses using the A and B values.

Transformer: A transformer converts electricity from one voltage to another voltage. Copper or aluminum conductors are wound around a magnetic core to transform current from one voltage to another. Liquid insulation material or air surrounds the transformer core and conductors to cool and electrically insulate the transformer.

Transformer life: The number of years that the transformer is in service. 30 years is generally used for transformer life.

Bid Evaluation Templates · 89
Bid Price
definition · 106
entering value · 98

C

Calc Losses (Disco) · 55, 68
Calc Losses (Generator) · 23
Calculation Method · 90
Calc Losses (Disco) · 55
Calc Losses (Generator) · 23
Enter A and B Directly · 5
Model Losses (Disco) · 55
Capacity Planner · 45, 89
Create Capacity · 47
Enter the Capacity Needed · 46
Save · 49
Set the Decrement · 48
Set the Reserve Margin · 47
Set the Years of Analysis · 46
Capacity Planner Control Panel · 49
Capacity Planner Control Panel Icons · 50
Capacity Planner Control Panel Table · 49
Capital Recovery Factor

definition · 106
Change-out Loading
definition · 106
Clear All icon · 50, 53
Coincidence Factor
definition · 106
Core and Winding Losses · 90
Core Losses
definition · 106
entering value · 98
Cost Data · 91
Capacity Costs · 91
Fuel Costs · 91
Cost Factors · 18, 41, 72, 82
Calc Losses (Disco) · 72
Calc Losses (Generator) · 41
Enter Losses Directly · 18
Model Losses (Disco) · 82
Cost of Capital
definition · 106

D

Data
Financial Data · 93, 99
Decrement
definition · 106
entering value · 50
Decrement icon · 50
Avoided Cost of Energy · 106
Avoided Cost of Generation Capacity · 106
Avoided Cost of System Capacity · 106
EC · 106, 107
GC · 106, 107
Years to reach change out load · 110
Demand Charge
definition · 107
Demand Side Management
definition · 107
Discount rate
definition · 107
DTCEM Interview
Calc Losses (Disco) · 56
Calc Losses (Generator) · 24
Enter A and B Directly · 5

E

Edit icon · 50
Energy Charge
definition · 107
ENERGY STAR Transformer Program
definition · 107
Enter Losses Directly · 5
Equivalent Annual Peak Load
definition · 107
Evaluating a Transformer Bid · 2

F

FCR
definition · 107
File menu
Exit · 93
New Bid Evaluation · 95
Open Existing Bid Evaluation · 95
Save As Template · 97
Save Bid Evaluation · 97
Financial Data · 93, 99
Fixed Charge Rate
definition · 107
Frequently Asked Questions · 101

G

Graph icon · 50, 53
Greenhouse gas
definition · 107

H

Heat Rate Calculator Dialog · 92
Help
About · 94
Contents · 94
Keyword · 94
Hours per year
definition · 107
HPY
definition · 107

I

Inflation Rate
definition · 107
Initial Transformer Loading
definition · 107
Installation Instructions · 1
Installing the DTCEM Software · 1
Intercept
definition · 107
entering value · 52
Introduction · 1

K

Kilowatt
definition · 107
Kilowatt Hour
definition · 108
kW
definition · 107

kWh
definition · 108

L

LF
definition · 108
LM
definition · 108
Load Characteristics · 17, 39, 71, 79
Calc Losses (Disco) · 71
Calc Losses (Generator) · 39
Enter Losses Directly · 17
Model Losses (Disco) · 79
Load Factor
definition · 108
Load losses
definition · 108
Load schedule
definition · 108
Load Schedules · 88
Loss Multiplier
definition · 108
LsF
definition · 108

M

Maximum load
definition · 108
Minimum acceptable return
definition · 108
Minimum load
definition · 108
Model Losses (Disco) · 55, 77

N

Net growth rate
definition · 108
New Bid Evaluation · 95
No-load Losses
definition · 108

O

Open Existing Bid Evaluation · 95
Open icon · 50, 53
Organization of this Manual · 3

P

Peak load growth rate
definition · 108
Peak Responsibility Factor
definition · 108
PL2
definition · 108
Present value (PV) Base Case
definition · 108
entering value · 49
Present value (PV) Change
definition · 108
entering value · 50
Present value (PV) Difference
definition · 108
entering value · 50

R

Rate Schedule
definition · 108
Rate Schedules · 88
RateVision · 53, 88, 96
Recommended Equipment · 1
Reference · 89
Required Equipment · 1
Reserve Margin
definition · 109
RF
definition · 109
Run icon · 53

S

Save As Template · 97
Save Bid · 44
Save Bid Evaluation · 97
Save Bid Evaluation as... · 95
Save icon · 50, 53
Saving *.cap files · 49
Saving *.tdf files · 52
Saving Capacity Plans · 49
Saving Transmission/Distribution Plans · 52
SC
definition · 109
Set RateVision Directory · 97
Setup
Set RateVision Directory · 97
Slope
definition · 109
entering value · 52
Supplier
definition · 109
entering name(s) · 98
Switch icon · 50
System Load Schedule
definition · 109

T

Target Efficiencies for Distribution Transformers · 103

37.5 - 50 kVA · 104
75 - 167 kVA · 104
TD
definition · 109
Templates · 89
The DTCEM Package · 1
Tile Windows · 98
TOC
definition · 109
Toggle Window · 98
Tools
Transmission/Distribution Planner · 99
Tools
Capacity Planner · 45, 89
RateVision · 96
Total Owning Cost
definition · 109
Transformer
definition · 109
Transformer life
definition · 109
Transformer Load Scale Factor
definition · 109
Transformer load schedule
definition · 109
Transformer Loss Factor
definition · 109
Transformer Size
definition · 109
entering value · 98
Transformer Supplier · 98
Transformer Type
definition · 110
Transmission/Distribution Charge
definition · 110
Transmission/Distribution Planner · 50, 99
Enter Inflation Rate · 52
Enter Total System Load · 52
Enter Transmission/Distribution Investment · 51

Set the Years of Analysis · 51
Transmission/Distribution Planner Control Panel · 52
Transmission/Distribution Planner Control Panel Icons · 53
Transmission/Distribution Planner Control Panel Table · 52

W

Winding Losses
definition · 110
entering value · 98
Window
Arrange Icons · 89
Cascade · 91
Close · 91
Close All · 91
Maximize Current Window · 94
Minimize All · 94
Restore All · 97
Tile · 98
Toggle · 98